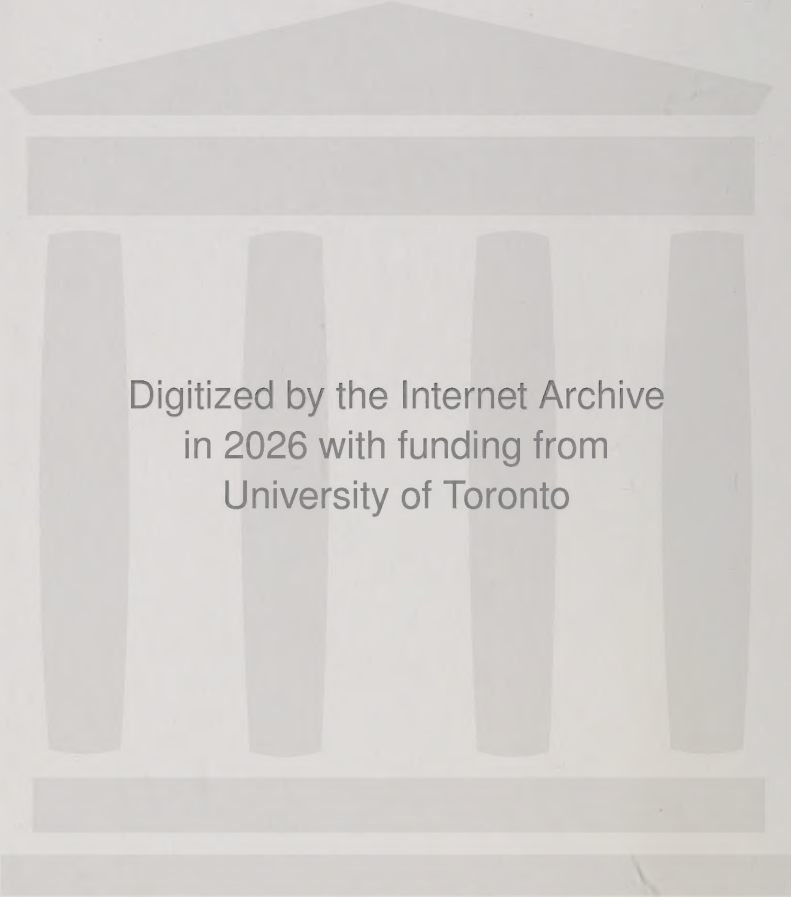




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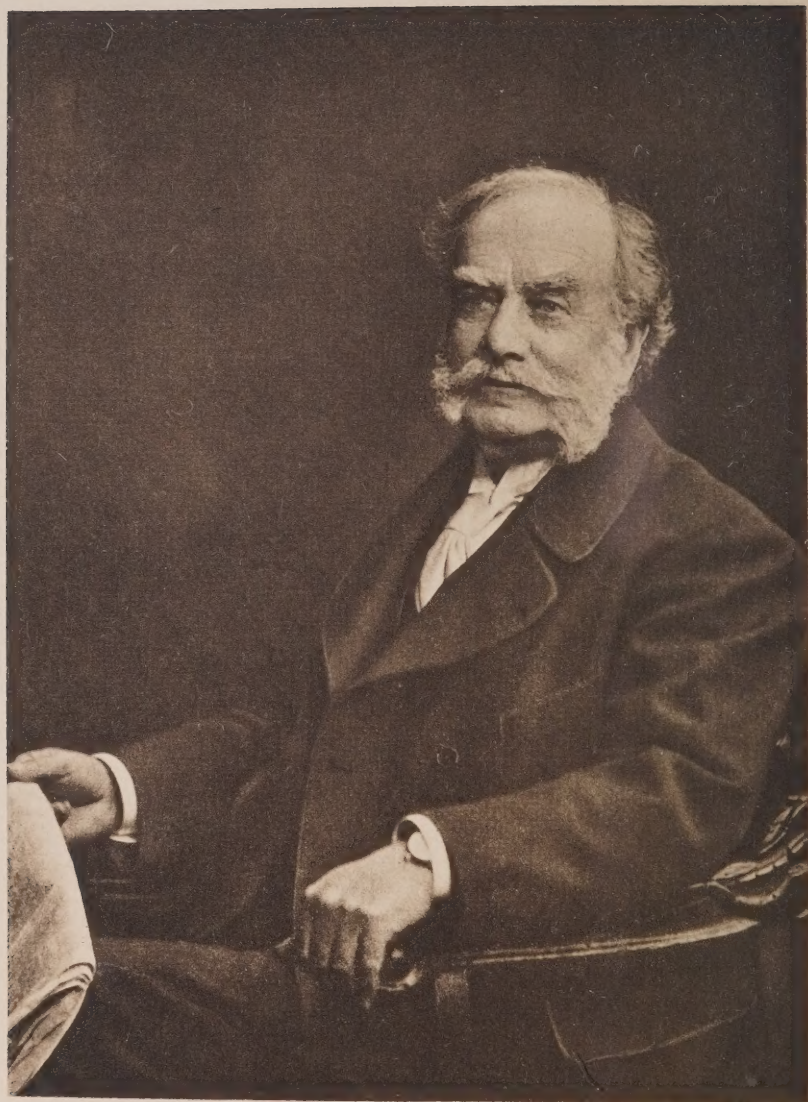


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ALFRED YARROW
HIS LIFE AND WORK



A. F. Garros

LONDON: EDWARD ARNOLD & CO

ALFRED YARROW

HIS LIFE AND WORK

COMPILED BY
ELEANOR C. BARNES
(LADY YARROW)

Author of "As the Water Flows"

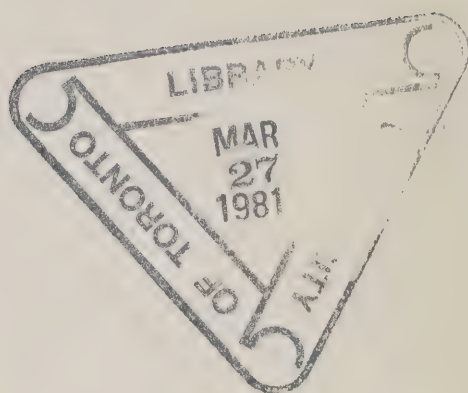
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LONDON
EDWARD ARNOLD & CO.

1923



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*Made and Printed in Great Britain by
Butler & Tanner, Frome and London*

FOREWORD

By VISCOUNT KNUTSFORD

I am responsible for this book being published in my dear friend's lifetime. He objected, and forbade this being done. I had to point out to him that we were all getting older, and that many of his friends who would have enjoyed reading it were dead, and that more were likely to die before he did, because he himself, showing no signs of decay, would probably have to be shot on the Judgment Day. He would not give way whole-heartedly, so the book goes forth to his friends with only his reluctant consent. One word more. His old family friend and connection, Miss Barnes,* is responsible for every word in this book. I know that it has been as much as she has been able to do to get Sir Alfred to read even a part of it.

The Life is the life of a man who, starting from the proverbial half-crown, or less, has never looked back. It is a life, therefore, that should gladden the heart of any young man himself starting life, if, and it is a big IF, he will only determine to have pride in character, and to put character first, and success second.

* Now Lady Yarrow.

AUTHOR'S PREFACE

The first portion of this book was written between the years 1909 and 1912, with Alfred Yarrow's consent (much of it, particularly the personal part, without his perusal), on the condition that it should not be published in his lifetime, a condition subsequently withdrawn. After Peace was signed, it was necessary to add another section showing some of his work during the Great War. In 1922, through the insistence of Lord Knutsford, echoed by a small band of friends, the conditions of publication were changed. This is explained in the foreword, full of that true and delicate feeling, so well known to the friends of this generous personality.

The personal details of Yarrow's youth were obtained from those who knew him well, e.g. his old school-master, his friend James Hilditch, his mother's old friend Mrs. Barnes, and several relatives. Many of his experiences were collected in conversation with himself, and from notes made at the time when he related interesting episodes to his friends.

For no part of this biography is the least originality claimed. I have gathered material, historical and technical, thoughts, words, and even sentences, from any source available. Ungrudgingly, and with extreme generosity, many people have come to my aid ; many

books have been my support. Consciously and unconsciously many expressions, and the phrases of others, having lived in my memory, have been used, because there has often seemed no other way to express the thought, and fulfil the ideal of the book.

For all the help gratefully gathered up, I offer my thanks and warm appreciation, and the book is dedicated in the name of all from whom assistance and encouragement have been received, to the young people of to-day, in the belief that the record of a life, earnest, good, and kind, must act as an inspiration to those who, because of their youth and consequent lack of opportunity, have not as yet done much for the well-being of others.

It may be that this book, written with sincerity, though with but little skill, will bring definite aim and purpose into some young lives. May it also bring back to a few older people true recollections of the friend they for a long time have loved.

E. C. B.

The author desires to express her indebtedness among others to the following people, from whom she has obtained help in the preparation of the work :—

Lord Knutsford—Yarrow's great friend, and to whose persistence it is due that this book is now published.

The late Mrs. Barnes—Yarrow's mother's greatest friend, and the grandmother of the author.

Miss Jessie Craig—Miss Barnes's Secretary, who worked with untiring patience.

The late Mr. William Crush.

The late Mr. James Hilditch—Yarrow's greatest friend in youth.

Mr. W. W. Marriner—A great friend of Yarrow's.

Commander Ranken, of H.M. Destroyer *Lurcher*.

Mr. John Rennie—Who visited Lake Nyassa in 1908.

The late Mr. Adolph Sonnenschein—Yarrow's first Schoolmaster.

Mr. Frank Stratton—Yarrow's Secretary, who collected and wrote part of the chapter on the Tigris.

Miss Clara Smith—Who prepared the work for press and compiled the Index.

She also appreciates very warmly the kind help and advice of Mr. Edward Arnold in the production of the book.

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CHAPTER I

EARLY YEARS AT HOME AND AT SCHOOL

Alfred Fernandez Yarrow was born in London on January 13, 1842. His earliest recollection goes back to the time when he was two and a half years old ; led into the quiet room by his weeping mother, he saw his little brother lying dead. He was then the only child of his parents.

His personality, with its ruling characteristics, has been drawn in a few touches by his first schoolmaster, a student of human nature :—

“The child was born with two leading features—a talent for engineering, and a passionate thirst for affection—to give and to receive.”

All through his career these two forces held their sway over the life before us, one influencing his professional reputation, the other, with its accompanying sensitiveness, creating to an unusual extent the joys and sorrows of his private life. One day his mother sent him to the pillar-box with a letter written to his father. She watched him from the window with her usual care, and saw him kiss the envelope several times before dropping it into the box. Joyfully she realized that she had an exceptionally affectionate disposition to deal with, and she was never disappointed, for no mother ever had a more devoted son.

At about eight years old he commenced working at his first mechanical device, and his choice of a subject is illustrative of the judgment which was so important a factor in his career—that is, suiting the invention to the time and need. An elderly aunt, Miss Lindo, frequently required his assistance in winding her wool, and the boy disliked sitting still with his arms



THE SELF-ACTING CANDLE EXTINGUISHER.

extended to hold the skein. An automatic wool-winder was the result of his determination to escape this task.

A few years later he tried another experiment in order to avoid the performance of a duty to this old lady. Miss Lindo was a strict Jewess, and there is a law which forbids a Jew to touch or come into contact in any way with fire upon the Sabbath. On Friday

evening, therefore, after sunset, when the Jewish Sabbath had begun, she could not blow out her candle without offending against this law, and it became Alfred's duty to go into her room after she had retired for the night, in order to extinguish the light. At this hour he was generally in his workshop, and the task became so irksome that one day he contrived a self-acting extinguisher. This was poised exactly over the candle, at a considerable height, and was attached to a cord which, after passing over a pulley fixed to the ceiling, extended downwards, and was tied by a very slight thread to a loop under the pillow. When the old lady mounted into bed and pressed the pillow down, this drew the extinguisher up towards the pulley, where it was checked, and the slight thread immediately broke, allowing the extinguisher to fall exactly on the candle. This arrangement, which worked perfectly, only came into operation once. No doubt it considerably alarmed the old lady, who, being short-sighted, had not noticed the erection. The boy received a stormy reproof the next morning from his offended aunt, for she failed to appreciate the ingenuity of her nephew, which had caused her unintentionally to break the Sabbath.

This device was soon put in the shade by a Dutch clock with weights, which kept fairly good time. It was fixed outside the house, and was made because the clock on a neighbouring church went so badly that it frequently caused annoyance.

Yarrow was of Jewish descent on his mother's side, and he has often said that, if blessed with any spark of talent, it came to him from those wonderful people, for whom he always had the greatest admiration.

When a student at the University College School, London, he observed that Jewish boys, although absent from the Saturday lessons, and in a considerable minority at the school, yet carried off more than half the prizes. Sometimes, when the Jews were spoken of with dislike and contempt, he would remark : " I have had unfortunate business relations with a clergyman, and with a peer, but I have never been cheated by a Jew." And again, " Character is formed by the overcoming of difficulties, and this form of education has been freely bestowed upon the Jews."

His mother, whose maiden name was Esther Lindo, was a daughter of the head of a firm of West India merchants in London. Her family was closely connected with that of Lord Beaconsfield, and Mrs. Yarrow, in her youth, knew him intimately. The Lindos have claimed with pride their direct descent from King David, and when some of Yarrow's acquaintances spoke of their ancestors having come over with William the Conqueror, and, as he expressed it, " were inclined to give themselves airs because their family helped to rob the ancient Britons of their rights," it amused him to say that he was related to Lord Beaconsfield, whose ancestors were on visiting terms with the Queen of Sheba !

Here is a story of his grandfather. At the age of sixty, Moses Lindo went through the Bankruptcy Court, owing to a fire which took place at the West India Island of St. Thomas completely destroying his possessions. Undismayed, he applied himself to rebuilding his fortune. In five years, he had partly regained his position, and invited his former creditors to a banquet. Under the plate of each guest he placed

a banker's draft for the full amount of the debt which had by his bankruptcy been legally cancelled. This was one of the happiest incidents in Lindo's life, and the thought of the amazed creditors and their surprise at receiving an invitation to dinner from the man who had been their debtor, was a pleasant reminiscence to the end of his life.

In those days it was usual for a merchant to live over his business premises. The home and the office of the Lindos was in the centre of London, and there a young clerk, named Edgar Yarrow, of exceedingly attractive appearance, found favour with his employer's daughter. Esther Lindo was a beautiful, warm-hearted girl, and the young man became enamoured of her, but in great distress, although Esther assured her lover that she ardently returned his affection, she declared an engagement to be impossible. Her father, she knew, would never consent to her marriage with a Christian, although on her part there was evidently insufficient attachment to the faith in which she had been brought up to lead her to renounce her lover. The young couple decided to meet as often as possible, but to say nothing about their affection for each other, and so discreetly did they behave that the old gentleman constantly invited his favoured clerk to visit the house, and remained blind to the reason of the young man's eager acceptance of these invitations. This state of affairs continued for sixteen years, and it is not related that anybody suspected the feeling which the young couple entertained so warmly for each other. In the year 1838, on November 28, her parents having both died, Esther Lindo was married to her lover in a Christian church. Many of her relations were greatly

distressed when the attachment became suspected, and on her wedding day the bride's eldest brother determined to interrupt the ceremony. He arrived, however, a few moments too late, and met the triumphant couple as they were walking down the aisle. At the time of the marriage, Esther Lindo was thirty-eight years old, her husband being some years younger. It need hardly be added that, after such abundant proof of patience and constancy, the lovers proved a most devoted couple, and that Alfred, their one surviving child, was brought up in the most affectionate and harmonious surroundings.

Edgar Yarrow was one of the kindest of men, keenly interested in all educational and philanthropic matters, of a trustful, gentle disposition, his good nature and credulity being frequently abused. He had not the business ability of his son, which gift was no doubt inherited from the mother. During Alfred's early life, and, in fact, until his father's death, the household was rarely free from the anxiety of a small and uncertain income, the result of Edgar Yarrow's being imposed upon by fraudulent people, or being drawn into unwise speculations by plausible company promoters. "Alfred," he would say to his son, "always believe a man honest until you have proved him the contrary"; and Alfred would reply: "Yes, father, but in a crowd it is better to keep your hands in your pockets, to avoid somebody else putting theirs in." In spite of difficulties, the home was a happy one, and although the clever, business-like little woman, Alfred's mother, could not fail to see the errors of her husband's judgment, she clung to him with unfailing love, never ceased to take the brightest view of every-





Mr. Edgar Yarrow.

thing he did, and kept the house cheerful and attractive, always hiding financial troubles even from her most intimate friends. When speaking of his early days, Yarrow passes lightly over his father's lack of business capacity, which caused so much distress in his home, but constantly recalls with affectionate pleasure the kindness, refinement and generosity of his disposition.

When Alfred was about six years old, his parents took a small house in Holloway, and he attended a school kept by a Mr. Newcombe, who used the method of teaching introduced by Pestalozzi, and called after his name. The little boy quickly attracted attention, and became the pride of a skilful young master, Mr. Sonnenschein. On hearing that the school was likely to pass into other hands, and that many changes would arise, Mrs. Yarrow, who had noticed the enthusiasm and talent of this young master, and perhaps also his love for her boy, asked if it would be possible for him to devote every morning to the education of the child, promising to give the schoolmaster a room in her own house for this purpose, and inviting him to gather other pupils there. He accepted the offer, and five little boys set to work. This arrangement continued until two years later, when Mr. Sonnenschein opened a school in his own house. He described his favourite pupil to the writer in these words :—

“ Alfred was an exceedingly pretty child at six years of age, of supreme talent, and quickly formed a friendship with me.

“ In a long scholastic career, he was quite the brightest boy I have ever met, and he learned as if by magic the subjects which he liked, making such astonishing progress that his parents were struck by it and gave credit to me for what was probably due far more to the child's gift.

“His progress was remarkable in realistic studies, such as arithmetic, algebra, geometry, science, physics and geography.

“In languages, however, he took no interest. The study in which he could make but little progress was reading, because in the method of teaching reading at that time there was neither plan, system, nor logic.”

In fact, his reading and spelling were very defective, and his difficulty in learning to read was so marked that Mr. Sonnenschein felt sure there must be something deficient in either book or teacher for the boy to find the reading lesson so irksome. This must be mentioned, as Alfred Yarrow's troubles first drew Mr. Sonnenschein's interest to the devising of some better plan for teaching children to read, the result of his labours being the method which, in a more or less modified form, is now generally used in British schools.

Another study for which Yarrow had no gift was singing. His mother, with Jewish instinct for song, desired that his voice should be trained. One day, the boy heard his mother inquiring what progress her little son was making in this art, and the reply was, “Madam, I grieve to say your son has neither voice nor ear.” After this the singing lessons were abandoned.

Although usually of a quiet disposition, he had from time to time those outbreaks of mischief which seem to be inevitable in active, restless boy-nature. In his school-days these pranks were generally connected with some mechanical device, and several instances are remembered with amusement. One evening, with a friend, Alfred attached a small air-pump to the gas-pipe in the workshop given up to him in his mother's house. Air was then forced through this channel into

the gas main. Of course, the air which took the place of the gas would not burn, and forty or fifty houses were temporarily put in darkness. This led to an investigation, but the trick was never discovered.

In the pursuit of the new study of electricity, the lads made a startling experiment with an old cook. They placed an iron shutter under the mat near the kitchen door. This iron shutter (by means of a wire) they connected to the outside of a Leyden jar. The handle of the door of the kitchen had also a wire connecting it by means of a switch to the inside of the Leyden jar. They then waited their opportunity, and when the cook, on her way into the kitchen, laid hold of the handle, her feet at the same time being on the mat, the lads connected the switch so that a complete circuit was made for the current of electricity, which thus passed through the cook's body, with the result that the startled woman dropped a tray of glass and china which she had at the time in her hand. The perpetrators, who watched the result, realizing that trouble might be expected, disappeared into the coal cellar and remained there until matters had reached a calmer stage.

On leaving Mr. Sonnenschein, Yarrow was placed at a boarding school at Reigate, where he did not learn much. The terms were £45 per annum, including extras. Two impressions remained uppermost in his recollection. One was that the head master knew very little, so that, if the boys desired to escape a lesson, the most approved way was to ask him to explain some difficult problem, and then, whilst he was considering what to reply, obtain permission—readily granted—to leave the class. The other recollection was that the

boys had to take brimstone and treacle every morning in the spring in true Dickens style. At this boarding school, where Yarrow had to rough it, and where it was extremely difficult for him to gain much information, he grew into a vigorous lad. When he was thirteen, University College School was chosen for his further education, and is warmly referred to now by the "old boy." Thomas Hewitt Key was then head master. Joseph Chamberlain and his brothers were among the scholars at the time, and if there was a disturbance in the school, it was surmised as a matter of course that one of the Chamberlains was at the root of it.

Yarrow's greatest friend at this time was Walter Rutt, who eventually became Chief Engineer to the city of Adelaide. The two boys walked together to and from school every day, and their devotion to each other was well known. They liked the same studies, and excelled to such an extent that with one other boy, Philip Magnus, they made an agreement as to which of the prizes each boy should work for, so as to avoid competing with each other, or running the risk, by dividing their attention among many subjects, of yielding the prizes to other competitors. During one term there was a special prize offered for the best perspective drawing of the University College Hospital, which could be seen from the school. All the boys retired from the contest except Yarrow and Rutt, and so well known was their honour and friendship that instead of remaining in the school to work, it was suggested that they should both complete the drawing at home, pledging their word that no one should give them the least assistance or advice. Great interest was evinced over this competition between the friends: on the

presentation day the headmaster awarded two prizes, for he declared the drawings to be equally good.

Once during the years spent together the friends quarrelled, and for some days they reached school and walked home separately. The friendship between them had been so remarkable that their form-master, an elderly man with a keen eye and a warm heart for his pupils, noticed the estrangement. Great was Yarrow's surprise one evening when, in the midst of his work at home, he was told that his master, Mr. Cook, had called to see him. The boy hurried nervously into the room, wondering what the visit could mean, and questioning if he had been guilty of some serious fault. The kind old gentleman laid his hand on the lad's shoulder and said, "I have come all this way to make up the quarrel between you and your friend Rutt. Never mind what has caused the separation. I don't wish to hear anything about it; but come with me to his house and shake him by the hand." Yarrow, who was very sensitive, and had suffered a good deal during this misunderstanding, was greatly moved by the earnest words of his master, and they went at once to Rutt's house, where a warm and lasting reconciliation was effected.

CHAPTER II

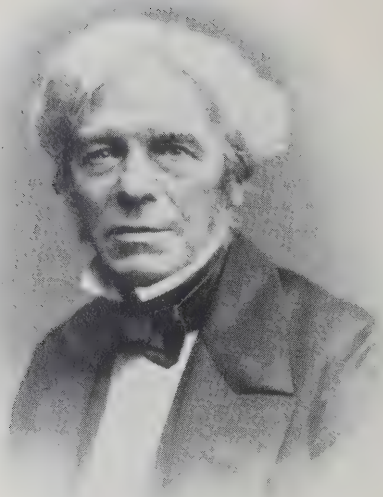
APPRENTICESHIP

When Yarrow was fifteen and a half years of age, a family connection, John Maylor, an engineer from Rio de Janeiro, happened to be in London, placing orders for the Brazilian Government with Messrs. Ravenhill, marine engineers. Through his influence, Yarrow was apprenticed to this firm for five years without any premium, which at that time was unusual. It was with much regret that his parents took him from school at such an early age, but they felt that the opportunity of placing their boy advantageously to study the profession for which he had shown so much talent might never occur again, and thus no time was lost in completing the arrangement. The work of the firm consisted almost entirely in constructing marine engines for naval vessels ; and in five years Yarrow went through the pattern shop, foundry, turnery and drawing office.

Upon his first introduction to factory life, a strong hint was conveyed that he was expected to "stand a drink all round." The question then arose as to how this drink should be brought in through the entrance gates, and a way out of the dilemma was easily found. A number of old patterns of wood, from which castings were made, were stored in a neighbouring warehouse ; some of these were supposed to be needed for immediate use, and a man was ordered by the foreman



ALFRED YARROW



PROFESSOR FARADAY

to take a large box and bring them to the workshop. On his return the box was apparently loaded with patterns, which served, however, to cover a goodly supply of jugs of ale.

The dining place patronized by Ravenhill's apprentices was in the Commercial Road, and the custom was for each lad to purchase a steak at the butcher's and carry it to a cook's shop, where it was grilled to a state of perfection hardly equalled, he declared in later days, at the Café Royal.

Whilst serving his time and obliged to be early at work, he constructed an arrangement which lit the fire in his bedroom, and also that in his mother's room, ten minutes before an alarum clock sounded. The two fires and the alarm were all connected ; so that by the time he was awakened, the fire burned, and the water was getting hot on the stove for washing. Tea and eggs were then prepared by his mother beside the fire in her room, where his breakfast was taken.

With two friends, Hilditch and Rutt, Yarrow delighted in attending every kind of scientific lecture for which tickets could be procured, not always an easy task. It was at this period of his life that he conceived a respect and veneration, which had a lasting influence upon his character, for one of the world's greatest scientists, Professor Faraday, to whom we owe, more than to any other man, the present development of the science of electricity. Yarrow loved to recall the charm of this great man, his modesty, his lucid expression, his deep penetration into the mysteries of nature, and the unfailing patience and encouragement shown to young students, many of whom would

remain behind after the lectures, seeking more knowledge. It is interesting to remember that among these enthusiasts, our late King Edward, then a lad, was often seen.

An illustration may be given of the magnetic influence acquired by Faraday over some of his students. On Sunday he and his wife attended a chapel in Barnsbury. Yarrow and a friend took care to walk in that direction just when the venerated professor might be expected, thus gaining an opportunity of raising their hats to him, then to hurry on through a side road in order to meet him once again before he reached his destination.

It was perhaps a sense of his own loss in being unable (on account of limited means) to pursue further scientific studies at this receptive age, which led Yarrow in after-life to sympathize in a practical manner with young men of talent, unable, for financial reasons, to follow a scientific career, and to take so much pleasure in devising means to help them and in founding scholarships for their benefit.

Rutt was studying civil engineering, and the lads met two evenings a week to compare their work, and to learn what they could from each other. Saturday afternoons Yarrow spent with a jobbing smith, as the apprentices at Ravenhill's were not allowed to enter the smith's shop in their works. When not engaged in the evening at lectures or engineering meetings, Yarrow worked with his friend Hilditch at various schemes, and also carried on much practical work with his lathe. He had bought for his workshop an old second-hand lathe, which cost about £5. Some years later, Mr. William Ellis (lecturer and author of several books on Political Economy) presented him with a

new one, which is one of Yarrow's greatest treasures. It was removed from his little workshop at home to his works on the Isle of Dogs when he began business there, and afterwards to a place of honour on the Clyde.

Amongst the mechanical contrivances of Yarrow and Hilditch should be mentioned a little apparatus for cutting up oranges. The custom in the square where he lived was for ladies to make their own marmalade, and the news spread quickly that the oranges in Mrs. Yarrow's preserve were all sliced with amazing rapidity by a machine made by her son. It was rumoured that this machine would cut up sufficient oranges in five minutes to supply a large family with marmalade for a year. It was not unusual in the marmalade season to witness the arrival of a maid-servant carrying a fruit-laden tray—"With her mistress's compliments, and would the young gentlemen be so kind as to cut up the oranges?"

The greatest achievement by the two boys, however, was the erection of the first private overhead telegraph in London. At this period very little was known by the public about the science of telegraphy. In attending the Juvenile Lectures at the Royal Institution, Yarrow had the opportunity of seeing some Wheatstone instruments exhibited by Faraday. Taking them as a guide, Yarrow and Hilditch erected a complete telegraphic installation between their homes. The little apparatus, which they made without any assistance, cost only 2s. 6d. (excepting the expenditure on the copper wire which connected the houses).

A discussion arose in the newspapers of that time as to who fitted up the first overhead telegraph, and the

following letter appeared in the *Daily News* of August 20, 1857:—

BOYS' ELECTRIC TELEGRAPH
SCIENCE IN SPORT.

To the Editor of the Daily News.

Sir,—In your impression of yesterday you give some particulars of the electric telegraph from the premises of Messrs. Waterlow & Sons, on London Wall, to Birchin Lane, remarking that it is the first instance of the construction of an electric telegraph for private purposes. Allow me to correct this statement, for there has been for three or four months past, in the road in which I reside, an electric telegraph extending about the same distance as the one you mention.

It is entirely the work of two school-boys, and communicates between each other's houses, crossing two public roads; but what I wish more particularly to call attention to is the small cost of this telegraph, not amounting to many shillings, which renders it likely that such an apparatus will come into general use.
—I am, &c., W.

Albion Road, Holloway,
August 19.

It is quite certain that the telegraphic connection between the houses of the young friends was the first private wire used in London. The erection of the overhead wires caused some consternation, and there was a good deal of difficulty in obtaining the necessary permission for passing the wire over the property of various householders. One old lady said she knew all about telegraphs, and was perfectly well aware that the wire would destroy her wall very shortly. Another neighbour called to complain that she could not sleep for thinking of that dreadful wire above her house. Another lady said that the lightning played on the wire all night, and sent a lawyer's letter, which resulted in a different route being taken, although the wire in its original position only passed high up over a corner of her garden. Again, permission was refused for the wire to be fixed to a chimney-stack until a written statement

was sent by the Fire Insurance authorities to the effect that no danger existed, and that it did not invalidate the policy. Miss Samuda, the sister of the well-known shipbuilder, was considered most courageous, for she went so far as to allow the wire to pass through the front of her house and out at the back. The friendship thus engendered between Yarrow and this enterprising lady lasted until her death at the age of ninety-five. Trouble was also experienced through the street boys tying stones and cabbage stalks to a long string and flinging one end over the wire, leaving these appendages hanging, causing horses to shy, and thereby becoming a source of danger. The parish authorities gave notice that the wires must be removed, but their objection was met by an arrangement of sliding rings, which could, by means of pulleys, be moved at will from end to end of the wire, and the hanging obstacles quickly cleared away. Innumerable other small difficulties were surmounted, and in the end success was reached.

Yarrow, in later years, often pointed out in connection with more important work, that the mechanical part of an enterprise frequently gives less trouble than the diplomatic side. To exert a personal influence over others, to be able to put yourself in the place of those with whom you are dealing, to show patience, courtesy, tact, and, in the end, to obtain what is desired whilst remaining on friendly terms with all concerned—this is the real art of business. The need in early years for carrying through thorny negotiations, and for exercising this kind of diplomacy, was doubtless valuable experience.

When everybody had been appeased, and the necessary permission granted on all sides, the telegraph

worked well and was in daily use. A brief description of this primitive arrangement is given, in the hope that it may possibly be of interest to schoolboys who are anxious to try similar experiments for themselves.

First, a mahogany case was made, somewhat larger than an ordinary cigar-box. Then a coil consisting of many turns of fine insulated copper wire was wound. Inside this coil was placed a magnetic needle, which was free to oscillate on a horizontal spindle which passed through the front of the case. The natural position of the needle, when no current was passing through the coil, was vertical, and attached to the other end of the spindle was a light metallic pointer which showed outside the case the movements of the needle inside. The position of the pointer indicated letters ; for example, if the top of the pointer moved to the right once, it might indicate the letter A, and if twice, the letter B ; or again, if it moved once to the right and then once to the left, it might indicate C. The boys, of course, made up their own code of letters.

It is well known that if a current passes parallel to a freely suspended magnet, it deflects the magnet. If the current passes in the opposite direction, the deflection of the magnet is reversed. This fact was discovered by Oersted in 1819, and Ampère, in the following year, suggested the adaptation of the principle to the sending of telegraphic messages.

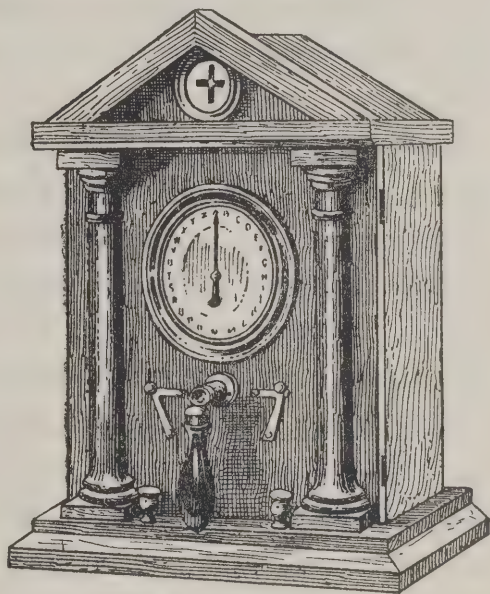
In the Wheatstone instrument, the needle is balanced on its centre, and the current is sent through the surrounding coil in either direction at the will of the operator at one end of the wire, an observer being stationed at the receiving instrument at the other end. By making the needle move to the right or to the left a

various number of times, letters are indicated and words spelt.

The current is made to pass in one direction or the other, and the movement of the needle is thus controlled, by means of a handle hung immediately below the pointer, the position of which changes the connection of the wires with the two poles of the battery.

The first practical application of this principle was in 1833, and, although many new methods have since been invented, needle telegraph instruments, as they are called, are still in frequent use, and many of them are to this day seen in railway stations.

A second instrument, as shown in the reproduction, with an alphabetical dial, was made by Yarrow when he was serving his time in the pattern shop at Ravenhill's; on being closely questioned on the subject, he explained that, if any of the principals were on their way to this shop, their approach would be immediately communicated to everybody by a boy whose special business it was to watch for the appearance of a chief. The instrument, if then in course of construction, would find its way out of sight at the end of the bench, and legitimate work would be at once taken in hand with exceptional energy. Similar practices are well known to every mechanic, and generally to the heads of



THE TELEGRAPH INSTRUMENT.

engineering establishments. Such knowledge of workshop ways is invaluable to employers, and can only be obtained by the actual experience a man gains when working in a factory. The practical employer knows well on entering a workshop where to look for the daily papers which are usually stowed away at the end of the bench on his approach. Many other curious customs are never forgotten, and are perhaps treated, in consequence, with some degree of tolerance by every engineer who has served his time as an apprentice before becoming an employer.

Photography was the next subject of absorbing interest, and a photographic apparatus was made out of a cigar-box. In those days every photographer had to prepare his own plates, which was a delicate and pretty process, as the plate had to be coated with a film of collodion, and it required very nice manipulation to hold it between the thumb and finger while the solution was being poured evenly upon it. After the plate was covered with collodion, it was "sensitized" by being immersed in a bath containing dissolved nitrate of silver some of which was taken up by the collodion. This operation had to be carried out in comparative darkness, a dim red light only being allowed, as the nitrate of silver would be decomposed by white or ordinary light. A magnifying glass was used for a lens, secured into the rim of a pill-box cover. In this way, by sliding the lid containing the lens in or out, the image of an object at which the camera was pointed was focussed on a movable ground-glass screen at the back of the box. When the sensitive plate was substituted for the glass screen, and the lens uncovered to admit light from the object to be photographed, the nitrate of silver was acted upon to an extent corresponding to the intensity

of the light, and subsequent treatment by the chemicals of the developing bath caused more or less complete decomposition of the nitrate of silver and deposit of black silver proportionate to the strength of the light falling on different parts. Thus a "negative" picture was developed with graduation from black to grey, representing the chemical or photographic intensity of the illumination of the different parts of the object. It is interesting to remember that silver, deposited as it is in this way, in a finely divided form, is not white like the silver to which we are accustomed; also, that the chemical intensity of the action of different coloured lights on a sensitive photographic plate is not in proportion to their brilliancy to the eye, a yellow or red light, for instance, having little or no effect on the plate.

With his constant companions, Hilditch and Rutt, and a few other kindred spirits, a Society was formed for reading and discussing papers on engineering and allied subjects. It was called the "Civil and Mechanical Engineers' Society," and the first meeting was held in May, 1859. A short reference to this Society will be of interest, as it quickly grew into importance and did excellent work.

It must be remembered that at this time Yarrow was eighteen years old, Rutt about the same age, and Hilditch a little younger. These lads, with other young engineers, first met in a schoolroom in Arbour Square, Stepney, later on in Cheapside; and again the Society moved towards the West End to the Freemasons' Hall, where Dr. Maw, the proprietor of *Engineering*, was elected President.

During the first year of the existence of the Civil and Mechanical Engineers' Society, the members numbered

about thirty; a young man named MacGeorge was President, and Yarrow Vice-President. Eleven papers were read, four of these by extremely young men, and the gathering was remarkable, not only for the youthfulness of the members, but for their enterprise in the choice of subjects. A casual glance at the Records of the Society shows that during the early sessions papers were read upon such widely varying subjects as "The Suez Canal," "Steam on Common Roads," "Electric Clocks," "Benevolent Societies," "The Renewal of King's Cross Station Roof," and "Ventilation of Sewage." In the opening term of the Society, Yarrow chose as the subject of his maiden speech one which still engages the attention of keen intellects without much apparent elucidation. His paper upon "Strikes" was read in March, 1860. This subject, which interested Yarrow so early in life, became in after-years one of very practical import to him, and his mature views, and somewhat original dealings with the problem, will be found later on in this book.

The sympathetic reader may picture, not without a gleam of amusement, this group of earnest young men, fresh from school, grappling seriously with the world's problems, discussing not only mechanical devices, the steam engine, the flying machine, many contrivances for increased power and movement, but eagerly solving, or shaking wise heads over, the most intricate social problems of the day.

During this period of hard work, both practical and scientific, when the day was spent at Ravenhill's, and the evening divided between lectures and the lathe, the time passed pleasantly enough, and Yarrow's life would have been exceptionally happy, but that he was at times very short of money. He was sorely troubled

about his father's financial position, and on one occasion went to a shareholders' meeting, held at the pit's mouth of a copper mine in Cornwall, belonging to an unlimited liability company, in which his father had been induced to take shares. The speeches and congratulations offered to all concerned by the directors did not interest him, and slipping away from the crowd he went down the shaft to explore the mine. There were large pieces of very fine ore for the inspection of the shareholders at the pit's mouth, but he failed to find any further specimens below and asked his companion, a miner, to explain this discrepancy. "Oh," said the man with a shrug of his shoulders, "that good ore comes from the Anna Maria mine on the other side of the valley. It was carted here a few days ago." Yarrow returned with the ominous news, but it was too late to save the crash. The only course open to his father in order to be freed from responsibility thus innocently incurred was to go through the Bankruptcy Court.

On completing his apprenticeship, at the age of twenty-one, Yarrow had a well-remembered interview with one of the partners at Ravenhill's. His outlook was not a bright one. His father's petition in bankruptcy had been filed quite recently, and he was, for the moment, without means. A few kind words and the bare suggestion of possible advancement, should he prove of use, would have bound young Yarrow to Ravenhill's possibly for life; and had his lot been cast in with theirs, it might have resulted not unfavourably to this firm, then flourishing but long ago extinct, having through mismanagement been obliged to close its doors.

The leading partner said in an unsympathetic tone that if Yarrow liked, he could have a stool in the drawing office and a salary of £100 a year, adding, "You had better accept it, for we know exactly the financial position of your father, and you cannot do any better." The young man felt the unkindness of the interview, and particularly resented the reference to his father. So the offer was declined with thanks, and he left Ravenhill's, not knowing in the least which way to turn for employment.

Just about the same time, two wealthy elderly gentlemen, friends of his parents, who knew the position of the family, invited him to breakfast, which appointments, it was understood, would give an opportunity for a little conversation about his future. On receiving these two invitations, the young man put on his best coat and attended punctually at the appointed hour. His mind was full of schemes. With a friend he had already several inventions patented, notably a steam plough and a steam carriage, which are described later, but he sorely needed capital, and even a small sum, he felt, would put him in a position to earn a livelihood. After breakfast (and as the process and result of each of the two visits were identical, only one need be described), the well-to-do host led his visitor into a private room for further conversation. Full of hope and expectation, Yarrow followed his venerable friend, but the interview resulted in disappointment. The old gentleman expressed himself very sympathetically: "There is one thing," he said, "which every young man, when starting in life, needs more than anything else." He paused, and Yarrow waited anxiously for the conclusion of the sentence, expecting the offer of a substantial cheque.

“ Good advice,” continued the old gentleman, “ is the basis of success, and when you feel in need of it come to me, and I shall always be pleased to give you the benefit of my long experience.” This concluded the interview. The downhearted young man felt advice to be a commodity for which at the moment he had little use.

How to bring forward his inventions without capital, how to obtain a few hundred pounds for tools and for opening a workshop—these were the questions which filled his mind, but upon which he was unable, during either interview, to speak a word. Help came later, however, through those from whom it was least expected, and to whom he would never have looked for assistance. A maiden aunt (other than the old lady who believed she had narrowly escaped being extinguished in place of a candle), Miss Amelia Yarrow, who had been a governess for many years, sent a sum of £200, insisting that this portion of her savings should be used by her nephew, in whose ability she, like his mother, had the most perfect confidence. At the same time, another cheque for £200 was sent by a black man in the West Indies—a wealthy planter who had met Yarrow’s father when in Jamaica, and who begged that his friend’s son would accept a trifling present towards his start in life. He was also much surprised by another offer of help.

Mr. William Ellis, whose lectures on political economy had a far-reaching effect upon his life, was an underwriter in the Indemnity Insurance Company, and combined exceedingly keen business ability with a somewhat exceptional standard of honour. This combination is illustrated by an interesting incident in Mr. Ellis’s life. A certain firm in the City, who

effected all their insurances with the Indemnity, lost a vessel on the Goodwin Sands. Through some carelessness she had not been insured. Meeting Mr. Ellis by chance the morning following the wreck, the head of the firm bemoaned his loss, adding that it was particularly unfortunate, as he had given his clerk strict instructions to insure the vessel with the Indemnity Insurance Co. before she left, which the careless fellow had omitted to do. Mr. Ellis replied that, as it was their full intention to have insured the ship, instructions to that effect having been given, and as the firm always insured with the Indemnity, he would recognize the claim exactly as if the insurance had been effected.

During his lectures on political economy, Mr. William Ellis had been attracted by the keen interest of young Yarrow, and, aware of his difficulty in starting an engineering career, sent him a most charming letter of encouragement, with the offer of £1,000 to enable him to start a workshop, adding, "If £1,000 is not enough, you can have £2,000." Only those who have met with unkindness and discouragement upon a very difficult path can realize how much this letter, with its generous offer, did to stimulate the young engineer's efforts; but although the letter was treasured, the financial help was never accepted.

Thus the outlook became more favourable, and when Messrs. Coleman, Agricultural Engineers, undertook to open an office in London, in order to push forward the invention of a steam plough patented by Yarrow and Hilditch, agreeing to pay Yarrow £100 a year whilst in charge of this office, he felt that, with this salary, £400 in the bank, a small income from royalties upon patents, payments for drawings and

designs, and fees for inspection and engineering evidence, his business life had satisfactorily begun.

After two years under these conditions, he began seeking for a practical engineer with a little capital, who might join him in starting some small works.

CHAPTER III

THE STEAM PLOUGH

The Yarrow-Hilditch invention of the steam plough, patented between the years 1860 and 1862, must now be explained; not because the mechanical or agricultural world gained by such a scheme, but because it formed an important step in Yarrow's career, besides tiding over a critical time. The work in connection with his patents was most valuable, and excellent experience was gained, both in engineering and in business knowledge.

Yarrow was an apprentice learning marine engineering; Hilditch was learning the business of a silk mercer. Both lived a city life, yet the first actual invention of the two friends was, strangely enough, a farm plough. The cause of the invention, however, is easy to find. The young men had attended the Royal Agricultural Society's Show, which is held every summer in some locality where fields can be obtained for the exhibition of machinery in operation. The steam ploughing arrested their attention more than any other exhibit, and they were immediately struck by the difficulties of obtaining in an open field fixed points from which to haul the ploughs, particularly when it is remembered that it was necessary constantly to move these positions, in order to be in line with each new set of furrows.

A lecture, entitled "Steam Cultivation," prepared jointly by the two inventors, was given before the Civil



YARROW-HILDITCH STEAM PLOUGH



LIGHT TRAVELLING ANCHOR
OF STEAM PLOUGH

and Mechanical Engineers' Society in 1861. The reader of the paper, Hilditch, was aged seventeen, and the chairman, Yarrow, eighteen. This paper appeared in *The Engineer*, and a few paragraphs, showing the sanguine enthusiasm of the young inventors, are quoted. The subject opens in this way: "The cultivation of the soil, being the most important operation in the whole province of agriculture, and one requiring in its execution a great amount of power, may be viewed as an immense field opened for the application of steam, and indeed, when the subject is placed in this light, it appears quite unaccountable that ploughing was not one of the first operations subject to its influence."

Hilditch proceeded to describe the various systems of steam cultivation which, up to this time, had been tried, and a summary of his paper, which was somewhat diffuse, follows.

In applying steam power to the cultivation of the soil, two different methods may be employed.

In one, the locomotive propels itself over the land and draws the ploughs after it.

In the other—the rope system as it is called—the engine is stationary, and the implement is drawn by means of steel wire ropes, which are wound on drums actuated by the engine.

With regard to the first system, it was found that the great weight of the locomotive had a detrimental effect on the soil over which it passed, and to this disadvantage must be added the consumption of power in its self-propulsion. These drawbacks led to this plan being abandoned in favour of hauling the ploughs by ropes.

The most successful rope system, prior to the

Yarrow-Hilditch patent, was one in which the engine was at one side of the field, and was fitted with two drums on which ropes were coiled. On the opposite side of the field was a very heavy travelling anchor, and the ploughs, which were grouped together in one frame supported on wheels, were double-acting—that is to say, the machine ploughed going towards the engine and also going away from the engine, it being hauled backwards and forwards between the engine and the anchorage. After each set of furrows had been made, both the engine and the anchorage moved on the necessary distance, so as to be opposite the fresh ground about to be ploughed. To the travelling anchor was fixed a pulley round which the rope passed, and as the anchor had to move onward from time to time, and also to resist the enormous strain when the plough was pulled towards it, it was fitted with large thin iron disks, which cut their way into the ground.

This was, at the time, the most approved method of steam ploughing. The weak point was that the movable anchorage, which had to be of great weight, was often pulled out of the ground, and leaped into the air, owing to the enormous strain thrown upon it. In this way serious accidents had frequently occurred; yet no method had been devised obviating the necessity of this heavy anchorage before Yarrow and Hilditch's patent was introduced. In this the powerful anchorage was done away with, and in place of one double-acting plough, two single-acting ploughs were substituted. Each ploughing machine, as will be seen in the picture, consisted of a group of ploughs carried on a frame with wheels. A wire rope connected each of these ploughs with the drums on the engine, and a very thin rope was secured to the back of one plough, from which it passed



VARROW AND HIS FRIEND HILDITCH DRIVING THEIR STEAM PLOUGH IN ESSEX

round a light anchorage to the back of the other, this anchorage being at the opposite side of the field to the engine.

One set of ploughs operated from the middle of the field to the engine, and the other set from the opposite side of the field, where the light anchor was fixed, to the middle of the field.

Whilst one plough was in action, making its furrows and approaching the engine, it also pulled the other plough, which was inoperative, back into position to start its next series of furrows, by means of the wire rope which passed round the light anchorage. The strain thrown on this light anchorage when pulling the single-acting plough backwards was a mere trifle compared with the strain involved in the old system when pulling the plough in operation.

It was pointed out that the advantage of the Yarrow and Hilditch system over all others was that it avoided one of the chief mechanical difficulties to the introduction of steam cultivation—which, up to this date, necessitated travelling anchorages of sufficient stability to resist the strain involved in hauling a plough while at work—by substituting two single-acting ploughs and a light anchorage for one double-acting plough and a heavy and powerful anchorage.

Concluding his paper, the young enthusiast said :

“ Steam, the great innovator, which has effected such mighty revolutions in all branches of industry, is at last invading, with irresistible force, the province of agriculture. The farmer, through short-sightedness, may object to and oppose the change, but he will not prevent it. His objection will have no more weight than those of the coach builders who opposed the introduction of railways. We may, I believe, conclude that, after all things have been taken into consideration, a large

margin of profit and advantage will remain in favour of steam, sufficient at least to ensure its general adoption as soon as the farmer is ready to receive it."

This was in 1861. Yet still, in spite of the introduction of motor tractors, the farm-horse ploughs its way contentedly along the furrow, and the peaceful English landscape is seldom marred by the unsightly steam engine in its green fields.

A few reasons may be stated explaining why the steam plough, although mechanically successful, was not generally adopted, as was expected by a large number of far-seeing people, who believed that steam would take the place of the horse in the field, as it had done in other industries where they had come into competition.

In the case of ploughing, the horse is travelling about $2\frac{1}{2}$ miles an hour, at which slow speed it probably develops its power most economically. In a competition between steam and horse power where the speed required is high, the conditions lend themselves to the use of steam, because the horse when travelling at a high speed is working under great disadvantages, whilst in the case of steam it is immaterial what speed is adopted, its efficiency being practically the same at all speeds. For example, it takes the same power to draw 2 tons at 8 miles an hour as it would to draw 1 ton at 16 miles an hour. The former would be within the possibilities of the horse, but the latter would be quite out of the question, whilst a steam engine could do either with the same development of power.

There are many other reasons why steam was not largely introduced for cultivation, such as the large outlay of capital involved, the difficulty of obtaining fuel and water in a field, and the cost of repairs.

Where fields were exceptionally large, the steam plough found favour. As an illustration, twenty Yarrow-Hilditch steam ploughs were exported to Egypt by order of the Khedive, for the purpose of developing the cultivation of cotton at a time when a sudden stoppage of the supply from the United States occurred in consequence of the Civil War.

In hot climates, however, the heat is generally too great for the horse to develop its power economically, and more ancient methods of ploughing are still followed. The ox stands the heat fairly well, and ploughs with grace and comfort. In some countries the cow will perform a good day's work in the field, and is also expected to give her milk as usual. Occasionally, a woman and a cow will draw the plough together, to the satisfaction of the former's spouse, who smokes his pipe and contentedly follows the procession.

From an artistic point of view, England has not lost in retaining the more antiquated form of ploughing. It is possible that the intense love of the Englishman for his horse, a national characteristic more marked in our race than in any other, except the Arab, has something to do with the retention of the agricultural horse by our conservative countrymen.

We perhaps should rejoice that the English landscape still shows the artist-loved scene of the contented old horse bending happily to his work, tended by the rustic who has ample time, should he desire it, between the moments when his dreamy attention is required, to muse upon the unseen, and transmute the beauty of the landscape into sweet verse for all generations. Although there is nothing to prevent the engineer combining the qualities of poet and artist with his technical knowledge, yet one thinks, surrounded by

the noise and vibration of steam, he would have, in the discharge of his duties, neither time nor inclination to "transform the weed to beauty."

After the steam plough had been patented and fully described in the technical press, an elderly gentleman called at Yarrow's house one afternoon and was interviewed by his aunt, who described him as "a dear, kind, old man—a clergyman on Sundays, and an engineer during the rest of the week." This was Mr. Coleman, an agricultural engineer of Chelmsford, who employed about 200 men. Having read about the Yarrow-Hilditch plough, he wished to take up the patent, and to have the sole right of making the ploughs. He undertook, after some negotiation, to make a complete set of the apparatus with which to experiment, and to pay the lads a royalty for the use of their invention. The drawings were made by the inventors, and when the plough was exhibited at work, it was considered a great success, many of the leading agricultural engineers in the country desiring to obtain the right of manufacture. Although Yarrow was still serving his time as an apprentice at Ravenhill's, he obtained permission from the foreman to go occasionally into the country to exhibit his steam plough, and, with Hilditch, spent many pleasant days ploughing in Essex, feeling an intense interest in agricultural affairs.

The royalties on this patent amounted in a few years to about £600, which was divided between the inventors.

The engagement with Messrs. Coleman in their London office enabled Yarrow not only to earn his living, but to add to his small capital, and even to look forward to starting works of his own.

Messrs. Coleman's London office for promoting the

steam plough was on the fourth story in the same building with many other commercial offices. When a footstep was heard upon the staircase, Yarrow would be seized with nervousness, grow hot and cold in turns, arrange the chairs for the supposed inquirers seeking a steam plough, and command the young and ignorant boy, who formed part of the equipment of the office, to appear as busy as possible, and to try to assume an intelligent expression. The poor lad's efforts to obey these instructions caused his chief much secret amusement, while the footstep, source of all the commotion, often proceeded to some other door, and calm reigned again in the little office.

Yarrow frequently obtained orders to prepare working drawings for all kinds of machinery, which were a source of profit, so that the time was satisfactorily occupied. He also acted as inspecting engineer for commercial firms, but curiously enough he was obliged to give this up because of his extreme sensitiveness, as he could not bear the thought of being suspected by those who employed him of accepting a bribe from contractors who desired him to pass their work. On one occasion he was to inspect several iron bridges made in sections destined for a railway being constructed in Australia, and the contractors offered him, very politely, a large sum if he would sign their certificate stating that the work was satisfactorily completed. He refused their money, but this experience showed him that it was not altogether unusual for such bribes to be offered and accepted. From that time any question on the subject, however carefully veiled by his employers, caused him to change colour, and to resent the imaginary suspicion so acutely that he knew he

must appear guilty. This troubled him to such an extent that he gave up all business of the kind.

Sometimes he had to give evidence in Court on technical subjects. On one occasion, notwithstanding the fire of cross-examination for three-quarters of an hour, he left the Court feeling that he had gone through the ordeal creditably. Outside, he met an old friend, who had been present at the trial, and who greeted him with the words : “ Well, Yarrow, I have attended many trials, but I have never heard anyone give evidence so badly. You spoke the truth, but you spoke it as if you were telling a lie.” This disheartened the young man, and he felt that in this branch of the profession also he was not adapted to distinguish himself.

At one time Messrs. Coleman, being much impressed with Yarrow’s individuality, made him a preliminary offer to become a partner, and to take over the management of their works. That the arrangement was never concluded caused him grievous disappointment ; yet had it not been for this apparent mischance Yarrow might have spent his life as an agricultural engineer at Chelmsford.

CHAPTER IV

THE STEAM CARRIAGE

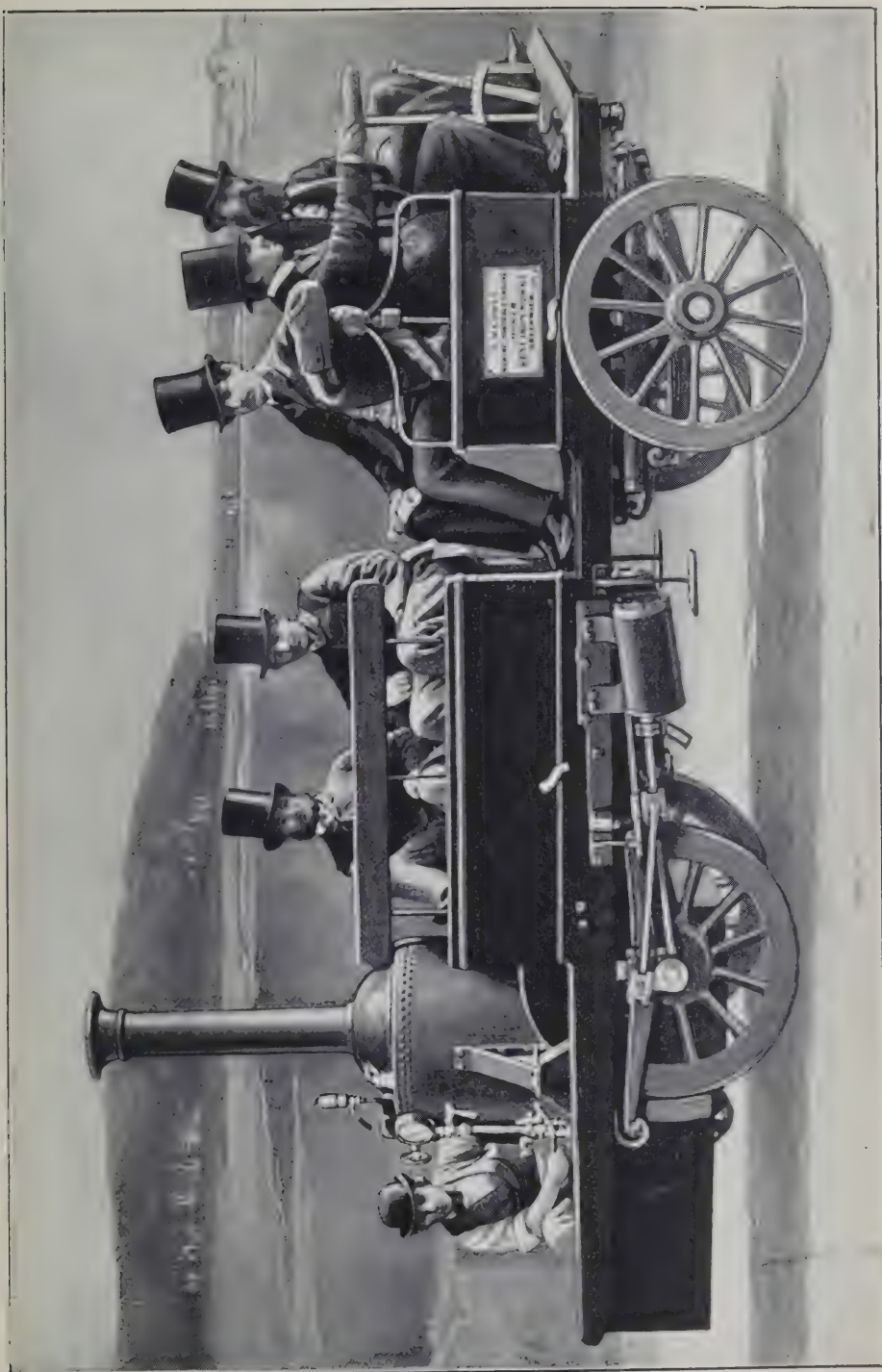
Several efforts had been made to introduce steam on common roads, and in the early 'sixties the Duke of Sutherland took much interest in this problem. A fire-engine owned by him, propelled by steam, which reached any London conflagration with great velocity, was called out on several occasions. He had also a steam carriage, and always attended these scenes himself; in fact, a look-out tower was erected on his house, so that he might see the direction in which any London fire occurred.

It appeared to Yarrow that a field was open for mechanical propulsion of vehicles on an improved plan, which should render them reliable and simple to work; and with Hilditch he designed and patented a special type of steam carriage in the latter part of 1861. This invention was taken up by T. W. Cowan, of Greenwich, subject to payment of a royalty.

A carriage was built and driven from Greenwich to Bromley, a distance of 10 miles, once a week late in the evening. At Bromley, Yarrow and some possible purchasers would stop a short time to take some refreshment, and then return to Greenwich, catching the midnight train to London. The swift passage of this steam carriage at night created a good deal of interest and excitement. One old lady, who heard it rushing past her house, ran to the window and, seeing flames

issue from the funnel of the boiler, declared that the devil was at hand. Unfortunately, on one occasion, the carriage, when going at about 25 miles an hour, met a mounted policeman. The horse took fright at this surprising apparition, and the policeman was thrown to the ground, breaking his leg. This, among other causes, led to a Bill being passed forbidding the use of steam upon the road, unless the carriage were preceded by a man carrying a flag. This put an end to the nocturnal trips, and to the evolution of the motor-car till the law was altered. No use could therefore be made of steam carriages in this country, and the law prevented their manufacture, even for foreign lands, owing to the difficulty of exhibiting them at work. The few carriages constructed, in spite of these discouragements, however, were considered most successful mechanically, the speeds obtained being nearly equal to those of the present-day motor-car.

To briefly describe the invention, it must be pointed out that its special feature consisted in the springs being allowed to move freely up and down without influencing the motion of the steam valves, although the engine acted directly on the shaft to which the wheels were secured. This was obtained by means of a link of the same length as the connecting rod and valve rod, so that the distance between the wheels and the engine was constant, irrespective of the movement of the springs. This distinctive feature of the Yarrow-Hilditch invention gave the elasticity essential when a high speed was required. Messrs. Handcock & Gurney had some years before experimented with steam carriages constructed on different plans, and they had proved fairly successful.



THE YARROW-HILDITCH STEAM CARRIAGE



THE 1575

The Yarrow-Hilditch steam carriage was shown at the International Exhibition in 1862, and attracted much attention. Unfortunately, it did not receive any award, because the Jury which had to deal with carriages considered it an engine, while the Jury which had to deal with engines considered it a carriage. When the mistake had been found out, the awards had been printed, and no alteration was allowed, in spite of the fact that the Juries of both sections wrote most courteously to Yarrow and Hilditch, stating that they had closely inspected the steam carriage, and had it come within their range they would most certainly have made an award in its favour. This afforded but little comfort to the disappointed young men. Owing therefore, to bad luck, and legislative interference, this business could not be looked upon as successful.

There can be no doubt that the motor-car was fore-shadowed by the steam carriage. It would appear, however, that Parliament was not then such a busy place as in the present day. The Bill prohibiting the use of steam on common roads was quickly passed, with the result that this innovation, which had been eagerly watched by many enterprising people as likely to revolutionize the whole manner of travelling, and also to lead to the development of a new industrial enterprise in Great Britain, was crushed.

It must be borne in mind that these steam plough and steam carriage inventions were conducted absolutely without capital on the part of the patentees. There was no money for experimental work, neither was it possible to bring any influence to bear upon financial people to persuade them to take up the patents. But the inventions impressed several eminent engineers, and brought Yarrow early in life into personal contact

with many distinguished people, which was of immense advantage to him.

In May, 1861, he read a paper, entitled "Steam on Common Roads," before the Society of Engineers at Exeter Hall.

It will be readily understood that at this period Yarrow and Hilditch had little time outside their engineering hobbies for the usual distractions common to young men of their age, such as music halls and theatres, which amusements seem, unfortunately, to be now considered among the essentials of life. Yarrow was often heard to say that such success as he achieved was in a great measure due to his having neither time nor means for anything which might draw him away from his profession. It became clear after a few years that neither on the road nor in the field was he to make a name as an engineer. Trusting the inevitable, he quickly abandoned the steam carriage, and when the progress of the steam plough appeared too slow for even the most sanguine to see any likelihood of developing this business, he turned his energies from country fields and city roads to the river, and later, to the sea. His love of boating and the happy holidays he had spent on the Thames brought his mind naturally in this direction. To achieve by steam he was determined—if not at a high speed on the road, nor at a slow speed in the field, then as fast as possible on the river and the sea.

CHAPTER V

STARTING THE WORKS

After two years in London, Yarrow had accumulated a capital of £1,000, representing royalties on the steam plough, payment for preparing working drawings, fees for technical evidence and inspection, certain gifts already mentioned, and his salary from Coleman. He considered himself a capitalist, and determined to make a reality at last of the ambitious scheme which had seldom been absent from his mind, viz. to possess some works of his own.

While at Ravenhill's, with his mind full of various half-formulated plans for the future, he had talked matters over with a clever foreman, named Sissons, whose savings amounted to about £800. At one time Sissons was so much influenced by Yarrow's enthusiasm that he agreed to start a small workshop with him. Yarrow lost no time in finding a suitable place, and in a few weeks everything was in readiness for the completion of the transaction; but disappointment followed. Sissons, whose capital would have been so helpful, and whose amiable personality would have made him a pleasant partner, at the last moment drew back from the venture. He feared to risk the whole of his capital and an apparently permanent situation for an uncertain future. No doubt, the factory which Yarrow had in view appeared to Sissons a miserable place compared with Ravenhill's extensive

works, and he could hardly imagine profitable contracts being executed there ; so Sissons suddenly retired from the agreement, and the capital of the future firm dropped from £1,800 to £1,000. This was a great blow to Yarrow, and although he felt an inward confidence in the ultimate success of the business, if properly managed, he could not but admit that Sissons (although his decision came somewhat late) had decided upon the more prudent course. Good-bye was said to Sissons, but Yarrow's hopes had been raised too high, and matters had gone too far, for him to give up the project. The workshop must be started ; but it was imperative to find a partner, with or without capital ; for a business could only be worked if one of the firm took charge of the shops and the other spent his time in seeking orders. In this dilemma Yarrow met and negotiated with a man named Hedley, without any capital, but one who, it was hoped, from his own representations, would have influence in obtaining orders to repair river steamboats, having been a foreman in an engineering and repairing firm. A partnership was entered into.

The future seat of the operations of Yarrow & Hedley must now be described. The yard and workshops were situated on the Folly Wall in the Isle of Dogs—not an attractive address. The word “ wall ” really means a “ dyke ” for keeping the Thames from overflowing the Island, which is below the level of the river at high water. The place consisted of two old cottages and a few broken-down sheds which adjoined the “ Folly ” public-house, for many years a source of great annoyance to the firm.

Yarrow had but little time to brood over the poor

condition of the works. The ground-floor of the two old cottages was quickly converted into a store. The upper floor became a drawing office, and the ship-building tools in the yard were made ready for use. The great attraction of the place in his eyes was that, being an old repairing shop in which the owner had failed, a few tools remained, and could be rented with the buildings, obviating the need of capital to purchase them. These tools consisted of a few punching and drilling machines, an old broken-down factory engine, and a boiler of 6 horse-power. The tools for the engineers' shop had to be purchased. The yard and buildings covered altogether about half an acre. There was a small frontage on the Thames, but this was cut through by two rights-of-way, which led to the "Folly" public-house, a small tumble-down old place mentioned in Macaulay's "History," from which we learn that Charles II used to pay clandestine visits there to the beautiful Nell Gwynne.

The "Folly" had also been a famous place of meeting for smugglers, who, when caught, were hanged at Blackwall Point, on the opposite side of the river, in full view of their friends at this favourite haunt.

One other historical association clung to the district. It is said that when Peter the Great visited England, in order to learn shipbuilding, he spent part of his time at Deptford Dockyard, and part at the shipyard formerly called the "Folly."

The first thing to be done was to erect a signboard, and this was easily obtained. A rare occurrence had taken place in the neighbourhood : a small public-house had failed and closed its doors. Yarrow bought the sign-

board for a few shillings, and painted it with the following inscription :

“YARROW & HEDLEY, Engineers.”

It was carefully considered whether a black board with white letters or a white board with black letters would be better seen in the distance, and as there happened to be at the end of the platform of old London Bridge Station two clocks, one with a black face and white figures, and the other with black figures upon a white face, this offered a good opportunity for solving the problem. It was discovered that in the distance the clocks could be seen equally well, but it was decided to paint the signboard black with white letters, because the area to be repainted from time to time would be less than if the ground were white and the letters black.

Yarrow & Hedley's next work was to build an engineer's shop for a few lathes and tools. This building had an area of about 1,000 square feet, and was made of old teak timbers (obtained from a yard where ships were broken up), galvanized iron, and glass.

All was ready in about two months, and then came a most anxious period in Yarrow's life. Unknown and untried, it was no easy matter to obtain work; he sought it in every quarter, and of every kind. A few small orders were obtained in the first year, but, although the partners both worked hard, money was lost. It was extremely difficult to know how to estimate for the curious jobs which were offered to the firm, which he was not in a position to refuse even at a low price. Then, too, the surroundings and plant were not such as to enable him to carry out work at

the lowest cost, and if a contract was completed without actual loss, he gave a sigh of relief. During the first year, the average number of men employed was twelve. The cost of labour amounted to £800, material £1,500, upkeep and maintenance (including rates, taxes, water, &c.) £600. Thus the total cost of work amounted to £2,900. The invoices sent out amounted to £2,800, so that the year closed with a loss.

The first order obtained was to construct a thief-proof door to a safe in a jeweller's shop at Brighton. The next piece of work was to erect an iron roller in Southwark Bridge Road, at the price of £11. This roller was fixed over the entrance of a warehouse to prevent the chain from a crane chafing the stone coping. Whenever Yarrow passed that way in after-years he would always point out the roller to his companions. Then came an order for some overhead travelling pans to be fitted up in a sugar factory. This had to be done at night, and was a curious experience. The walls and floors were covered with sugary treacle, and in this sticky mass were thousands of cockroaches. These beetles were swollen with the amount of sugar they lived upon, and they became crushed up in the general mass, no doubt saving thereby a great loss of treacle. In fact, the men used to say that the profit of the business lay in the cockroaches. The place was never cleaned, possibly owing to the loss of sugar which it



57, SOUTHWARK BRIDGE ROAD, LONDON.

would involve, and the whole of the treacly mass, including cockroaches and dirt, worked gradually down into an underground well. The juice from this well was pumped up to the top of the building, and then filtered through animal charcoal, reappearing transformed into beautiful transparent sugar.

The ready money of the firm was generally hidden under a board in the floor, but a little money was kept in an important-looking cash-box in the office. One Friday night, this cash-box, with a large number of threepenny-pieces (very convenient for paying wages on Saturday), was stolen, and for some days the trade of the Island was flooded with these small coins.

Among a variety of other work, including a very complete apparatus for roasting coffee, and some match-making machinery, was the repair of a boiler in a jam factory. The estimate, which allowed a very small profit, amounted to £25, and after the work was satisfactorily completed, Yarrow called to collect the account. But the manager was always engaged, and it seemed impossible to obtain payment. One day, when upon this errand, Yarrow met a friend who, after greeting him, said—"What are you doing here? I hope you are not working for this firm." "Yes, I am," said Yarrow, "and they owe us £25." "You can put that down as a loss," said the friend, "for they never pay anybody." Yarrow hurried on to the office and pressed to see the head of the firm. He was told that this was impossible, as Mr. B—— was at prayers. He declared his intention of waiting, and, after a long time—presumably when prayers were over—he obtained an interview. He explained how important the small sum was to him, showing that it had been almost

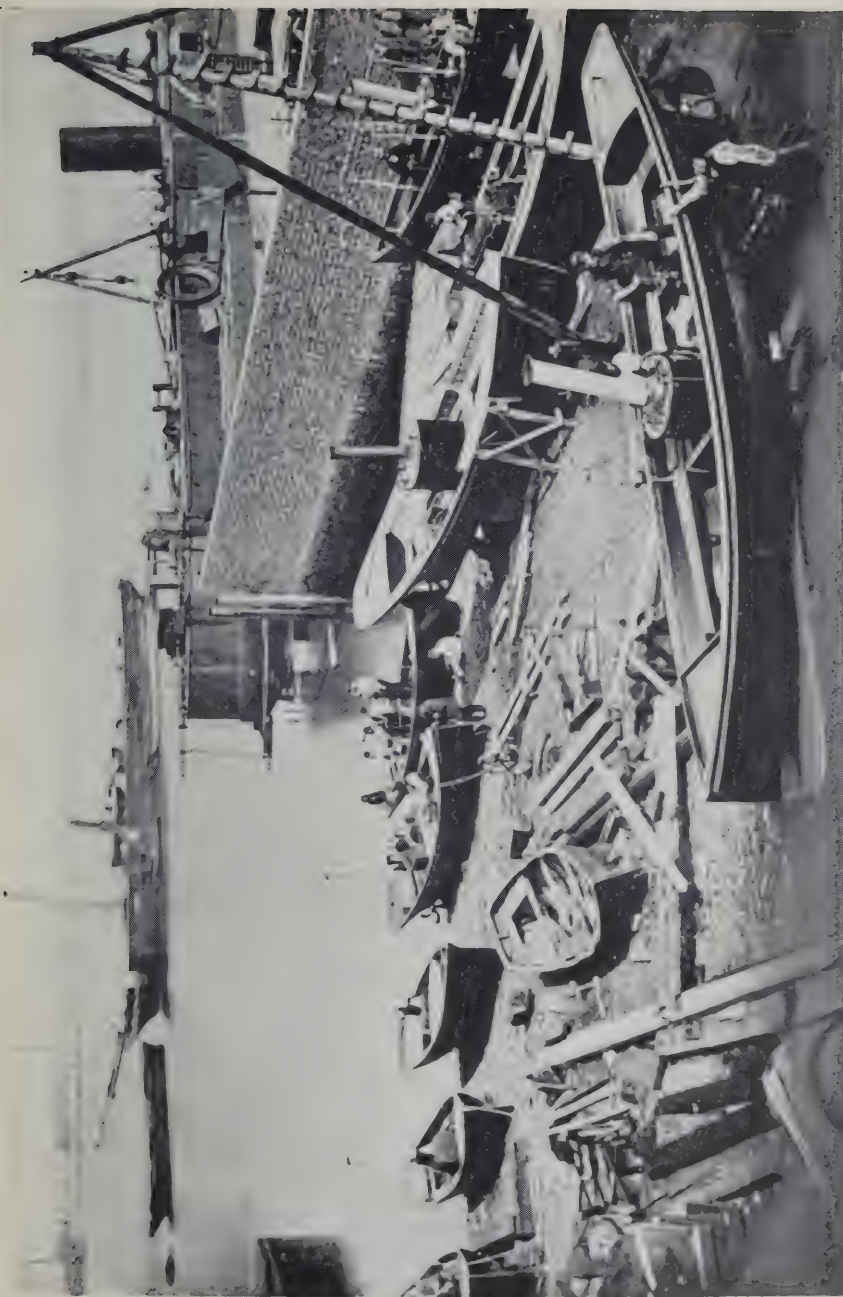
entirely expended in labour. Mr. B—— promised that a cheque should be posted that day, but it did not arrive, and no further notice was taken of the debt. Yarrow's mother, on hearing of this trouble, did all she could to cheer her son. She sent to the jam factory a large order for necessary household goods, not only for herself, but for friends. Candles, soap, jam and pickles arrived in abundance, and were safely stored, but when the account was presented, Messrs. B—— received in reply a notification of the amount due for work done on their premises by her son, which corresponded to that owed by Mrs. Yarrow for groceries, and no more was heard upon the subject. The soap, candles, etc., are said to have lasted for many years.

The work of the first year was, perhaps, more clearly imprinted upon Yarrow's mind than that of any subsequent time. Every order, every price, every expense comes clearly back to his mind, deeply impressed by effort and anxiety. For several years he made all the drawings, kept the books, paid the wages, and obtained the orders, whilst Hedley superintended the carrying out of the work. Twice a week Yarrow used to set off in a rowing-boat to visit the various steamers recently arrived, which lay at anchor in the Thames, immediately below London Bridge, in what is called the "Pool." Having climbed up a rope-ladder at the side of a ship, he would inquire if any repairs to the machinery were needed. The obnoxious part of the business was that, after a preliminary chat with the engineer-in-charge as to what was required, in order to obtain the work it was necessary to invite him to come ashore and have a drink at the "Queen Elizabeth." This meant two drinks, to be paid for by Yarrow, who

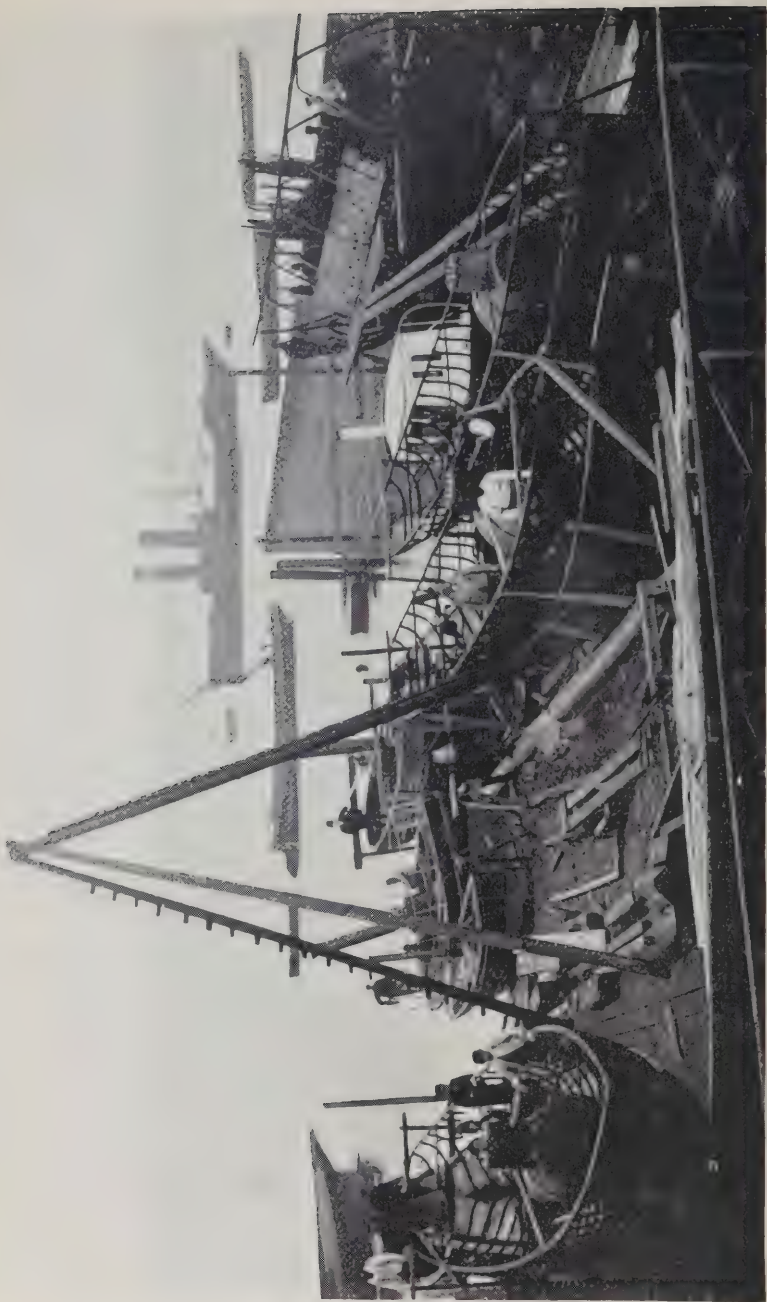
generally contrived to upset his own upon the floor when he was not observed. On other occasions, when he was climbing up the ladder to gain his footing on board, a bulldog left in charge would rush to the gunwale with a savage growl, and look fiercely down upon him, with the result that he made a speedy retreat. After the first year, these visits to the ships on the Thames were discontinued, chiefly because the orders could only be obtained through the medium of a glass of grog.

In the second year the firm tried to secure work on a larger scale, with the result that they lost on almost every contract, and their books showed a deficit of about £2,000. This was the hardest period, financially, in the firm's existence. Yarrow's father constantly urged him to close the works, and to go through the Bankruptcy Court, declaring it to be the only honourable course before him. But for his mother's never-wavering faith in all he did, and her unshaken confidence in his ultimate success, he must have lost courage.

After the disastrous result already described of two years' work, as it was apparent that his present business brought in no profit, but rather seemed indissolubly connected with ruin, it occurred to Yarrow, in the spring of 1868, when looking round somewhat hopelessly for some engineering development, that the building of small steam-launches might be a promising direction in which to turn. Perhaps it should be mentioned that his earliest idea of building a boat occurred whilst he was at Ravenhill's, when, in their spare time, he and Hilditch completed a little steam-launch for the Thames. Yarrow made the drawings



THE ORIGINAL YARD, ISLE OF DOG



THE FIRST ATTEMPT AT IRON SHIPBUILDING

and patterns of the engine ; the boiler was made by a friend ; the cylinders were cast by a local founder ; and the completed engine was finally put into a boat. The launch was named the *Isis*, and proved a great joy to the young men in their spare time.

This class of work appealed strongly to Yarrow, and on deciding to follow it up he began advertising as follows :—

“STEAM-LAUNCHES.—Anyone wanting a steam launch would be well served if they came to Yarrow and Hedley, Isle of Dogs.”

This was the last resource. Without capital, and with the business considerably in debt, but with increased experience, Yarrow awaited developments. Within three days of the appearance of this advertisement, an old gentleman, Colonel Halpin, came to the yard. He placed an order for a steam-launch, 24 feet in length, to be fitted with a small cabin to hold four people. It was to have a single-cylinder engine, and a vertical boiler of 3 horse-power. The price was to be £145. This little boat was built in three months, and cost £200, so that the financial outlook had not yet improved. Yarrow, however, was delighted with the boat, and himself steered her up to Colonel Halpin's house at Isleworth one Saturday afternoon. Somewhat later than was expected, owing to having lost the tide through many finishing touches being required at the last moment, he arrived in a begrimed and oily condition ; but the Colonel, who had constantly visited the yard during the construction of his boat, and whom Yarrow always referred to as a “charming old gentleman,” received him very warmly and insisted on his

going with him into the house, black as he was, to have some luncheon. This steam-launch was quite a show boat that summer, and it may be of interest to record that, although Yarrow made a loss in building her, he bought her back after the summer season for £100, and sold her the same day for £200. After the following summer she was again purchased by Yarrow for £100, and sold for £300 to a Russian nobleman, who took her to Petrograd.

Yarrow pushed this new business for all it was worth. He started one day from Oxford with a number of framed photographs of Colonel Halpin's launch, landed at every inn on the Thames, and asked permission to hang one up in some conspicuous place. This led to many launches being ordered.

Amongst the early contracts of the firm were a number of boats to be attached to large ocean-going steamers. On one occasion a letter was written by the Secretary of a Liverpool steamship company, complaining that one of these launches was reported by the shipbuilders to have a boiler of weak construction, and to be unfit for service, adding that the boiler had actually given way. On receipt of this letter, Yarrow, much disturbed, at once went north, arrived at six o'clock in the morning with the workmen, and passed unobserved into the yard of the shipbuilder who had sent in this unfavourable report. He went down to the shore, where he found two men cleaning the launch in question. He asked the men what they were busy with, and what sort of a boat they were working upon. One of the men volunteered the information that the young governor had been out with some of his friends on Sunday, had got "tight," and let the water out of the boiler, which was the cause





Alfred Yarrow.
Age 25.

of the crown of the fire-box having come down. No further information being required, the visitor left the yard, took the first train to Liverpool, and the same afternoon called upon the Company's secretary and placed the facts before him. Needless to say, no further complaints were transmitted.

For seven years steam-launches were built without a pause. No other work was undertaken, and the old fault of contracting at a price which left a deficit no longer occurred.

About this time Mr. Edgar Yarrow paid a visit to the West Indies, and on his return from the tropical climate he caught a severe chill. After an illness of six months, at the age of sixty-three, this gentle, kind, handsome man, adored by every child who knew him, deceived and imposed upon by every cheat who could escape the vigilance of his wife and son; whose probity and honour were trusted and respected by all, even in the darkest days, and who was loved and tended with never-failing affection and solicitude in his home, was laid to rest.

After his death, Messrs. Stiebel, the firm for whom her husband had worked for many years, allowed Mrs. Yarrow a yearly pension. Although her son was at the moment unable to pay for his mother's needs, he determined that no one should deprive him of this privilege directly he could afford it. This he was unable to do until eighteen months after his father's death, when he wrote Messrs. Stiebel stating that he was glad to be able for the future to provide for his mother without their assistance.

Yarrow made his own designs in the evening (the

drawing office being the upper story of the old cottage), sitting there until the rats came out to seek their supper, which was usually about ten o'clock. Sometimes one would dash over his drawing-board, leaving the print of its little feet on the paper; then Yarrow would pack up his things and leave the forsaken spot. He was often warned that the isolation rendered it unsafe for him to remain there so late at night quite alone. At home the devoted mother waited for him each evening, greeting him with the tenderest care ever lavished upon a weary, hard-working young man. She would invariably send the maid to bed, and attend to the preparation of the evening meal herself. Whilst the supper was being prepared, Yarrow would rest on the sofa, with the happiness of success upon him, and the little old lady, then seventy years of age, delighted to wait upon the son who was now everything in life to her. The two were united by a very unusual affection, and to both the close of the day was its happiest moment.

After purchasing by degrees all the tools and plant essential for the perfect execution of his work, the first luxury in which Yarrow indulged was a carriage for his mother. It was bought without her knowledge, and a man of very sober appearance was engaged as coachman. Yarrow would not trust his own judgment in the selection of a horse, but the jobmaster agreed to be responsible for sending a quiet animal whenever desired. The next fine Saturday afternoon after these arrangements were completed, the coachman, horse and carriage arrived at Yarrow's gate. "Mother, your carriage is here, come and see if you like it," was the announcement. The happiness and excitement of the occasion is one of Yarrow's most pleasant

memories. Mrs. Yarrow put on her bonnet, stepped in and out of the carriage, tried all the seats, and walked round it, to her son's extreme delight. From that time, almost every fine afternoon the carriage might be seen filled with ladies, for Mrs. Yarrow always invited her friends to share in this unexpected luxury, doubly dear to her because of the giver.

Sometimes in the summer a short holiday was spent out of town. Gravesend was then a seaside resort, just as Blackheath was a country suburb. A particularly happy time was spent one year at Blackheath, and early in the afternoon (for Yarrow's holidays generally implied half a day's work) he would leave the factory, and, crossing the Thames in the ferry, reach the grassy slopes of Greenwich Park, where he could immediately distinguish, on a seat commanding the farthest view of the river, the eager little form of his mother awaiting him. On some occasions, business would take him suddenly to the North, and a wire sent home from the works would ensure his mother's arrival at the departure station, all ready for the journey. On these hurried business trips he always desired her company, and she was delighted to go everywhere with him. Sometimes, when he was detained, she would be kept waiting an hour or two at the Station Hotel, but on his arrival he would find her invariably bright and cheerful, generally the centre of conversation and attraction, chatting genially to other travellers, who never failed to be interested and amused at the witty, genial old lady, whose favourite topic was her beloved son.

One more story is added to this period. When returning in a mail-coach from the North of Scotland, Mrs. Yarrow took a chill, and her son's whole time

during the long journey was spent in watching over her, wrapping her up with extreme care, and attending to all her needs. On reaching Inverness, two old gentlemen asked if he would favour them with his name. He naturally inquired if he might know why this was desired. They replied that nothing on the journey had interested them so much as his tender attention to his mother.

Yarrow had made up his mind not to think of marriage until his mother was well provided for. Indeed, he was so intensely happy in his home life and so strenuously busy in his working hours, that it is somewhat doubtful whether he would ever have decided upon such a step during his mother's lifetime but for her constantly expressed wish that she might see him with a wife and children to love and cherish him before she died. The old lady felt truly his absolute dependence upon affectionate home surroundings, and, although at this time in perfect health and vigour, she naturally believed it unwise for her son to concentrate all the love of his passionately affectionate nature, and to depend entirely for that home companionship so essential to him, on an old lady who could not hope to live much longer.

At a party given by Mrs. Yarrow, a very beautiful girl, Minnie Franklin, was introduced by an acquaintance of the family. Yarrow spent much of the evening in her society, and a few days later called at the house of her guardian, to ask her to be his wife. The young people became engaged, and were married three months later, in 1875. Six children were born to them.

Unfortunately, the partnership between Yarrow and



Mrs. Yarrow.

Hedley did not work smoothly, the latter being utterly deficient in that enthusiasm which Yarrow felt to be essential in building up an industry, and in carrying out the far-reaching schemes and costly experimental work to which he looked forward in the future. In many ways the partners were ill-assorted, and it was evident to Yarrow that a scientific industry could not be developed when a large portion of the energy of the partners was devoted to disagreeing. Moreover, as the business increased, the occasions for possible differences would become more numerous, and the difficulty of separation augmented. In 1875, therefore, Yarrow endeavoured to persuade Hedley to retire, offering that he should retain his interest in the business, viz. one-third of the profits. This he refused, and the partnership was then dissolved, Hedley drawing out a large sum on condition that he should not open a competitive business. He was somewhat advanced in years, and proposed to retire into Wales with his capital.

The dissolution was accomplished just before Yarrow's marriage ; and, as he was about to leave England on his wedding tour, Hedley agreed to remain and take charge of the works during his absence. All was carried out, apparently in an amicable manner, but whilst in Rome, Yarrow received a telegram from his watchful mother, telling him that, contrary to the agreement that no competitive business should be opened, Hedley was actually negotiating for a piece of ground adjoining the works. It also appeared that Hedley had been endeavouring, while Yarrow was away, to divert contracts which were intended for the firm, stating that he would be shortly opening his own yard, and that customers had far better place their

orders with him, "for," he explained, "Yarrow has the money, and I have the brains." It would certainly have been a calamity to have such a competitor at his gates, and Yarrow telegraphed from Italy to the owner of the adjoining property that he would pay him £50 more for the land than any sum which Hedley might have offered. After travelling day and night, Yarrow saw the owner of the property before either going home or into his works, and within half an hour the land was his. Information was received soon after that Hedley had again set at naught the agreement, and had bought a yard about a quarter of a mile away. There he started a small, unsuccessful business, and soon lost all his money.

The business of Yarrow's shipyard now advanced by leaps and bounds, and as its young chief was drawing around him a small, reliable staff, enthusiastic about the work, the necessity for a partner no longer existed.

"The Folly" public-house still remained, and audaciously shook her cheerful sign in full view of the enemy. It seemed an impossible task to gain possession of this objectionable little piece of Old London. To make matters worse, two rights-of-way passed through the shipyard. One led to the front of "The Folly," the other to the back, and the workmen appeared to gravitate there during working hours whenever the slightest opportunity occurred. It has often been said that—"One man's meat is another man's poison," and it will be easily realized that, whilst this house of entertainment was a source of great concern to the firm, as the men were constantly found within its doors, the shipbuilding industry was,

on the contrary, a great boon to "The Folly," whose business and prosperity increased with the development of the yard.

For some years Yarrow had tried to negotiate the purchase of this property, but without success. The tenant knew how anxious the engineers were to obtain possession, and the price was correspondingly prohibitive. It seemed that Yarrow had this time an impossible task before him, when quite unexpectedly a fortunate circumstance arose. In ten years the reversion of the freehold ground upon which the much-desired tavern was built would fall in, and through the death of the ground-landlord in 1875, this reversion was compulsorily sold by auction. There was apparently no competition for the purchase. No one cared to buy a property of which possession could not be obtained for ten years, and from which no appreciable benefit would accrue until then. The tenant did not appear affected by this sale, as he looked forward to making a fortune and retiring within ten years, before his lease should expire. Yarrow arranged that a friend should buy the reversion of the freehold for him. Now the lease, when examined, was found to contain the usual clauses as to the building being kept in good repair by the tenants, and to comply with its terms would involve the spending of a large sum of money. After the freehold had been acquired, a surveyor was sent to visit the inn and inspect it. He discovered that the tenant had neglected to conform to the conditions of the lease. A long list of dilapidations was drawn up, and a notice served instructing the innkeeper forthwith to put the place in thorough repair, which would involve an expenditure of about £1,200. Yarrow had several times recently

interviewed him, and offered a considerable sum for the possession, but without success. The same day, however, upon which the notice of dilapidations was served, the innkeeper paid Yarrow a visit, stating in an unusually friendly manner that he was at last tired of the business, had made money, thought of retiring, and, in short, was willing to consider the sale of his lease, adding that the place was in good repair, did a fine business, and Yarrow might buy it that day if he pleased. Yarrow, however, to his visitor's surprise, appeared to have changed his mind, was no longer eager to purchase, was too much occupied to attend to the matter, did not feel sure that the house was in such good repair as was represented, submitted that ten years was a very short lease, and brought forward other objections. The result of the interview was that the tenant was thankful to transfer the place for a small sum, congratulating himself upon bringing the business to a successful conclusion so quickly, and smiling to think what a shock Yarrow would receive when the notice to spend £1,200 on the old place should be served upon him by the owner of the freehold. Within a few weeks the front rooms of "The Folly" became a drawing office, and no doubt the previous tenant, who carefully avoided the place, was considerably surprised not to receive a lot of abusive correspondence for his duplicity.

At the age of ninety-five, Yarrow's mother died. His affection for her was well known at the works, and his men, wishing to show their appreciation of his devotion, sent such a quantity of beautiful flowers that two large conveyances were needed to carry them to the grave.

Yarrow was greatly touched by these marks of sympathy, and wrote the following letter to his men :

February 9, 1889.

“MY DEAR FRIENDS,—To my mind one of the rarest and at the same time the most beautiful feature of character is a warm heart—from such alone could so kind an attention as the one you have just paid me be due therefore I especially value it far very far more than I can express.

“The attention and kindly feeling which you have shewn me to-day will be for ever a bright spot in my life which I shall never forget and which I fully appreciate, indeed I look upon these kindnesses as among the greatest pleasures of life.

“The Workmen’s Tribute will be for ever riveted in my mind and you must never forget that I am a workman quite as much as you, this is a distinction which I would never exchange for another.

“My sympathies are in the shops and my only regret is that I cannot be more among you.

“Again thanking you for a kindness shewn me in the kindest possible way.

“I am,

“My dear Friends,

“Yours very truly,

“A. F. YARROW.”

From the time of this loss, to use his own words, he felt Mrs. Barnes, his mother’s friend, to be his most valued adviser, and this must be mentioned, because long afterwards, in 1903, when his daughters were married, this lady, then ninety years of age, and her granddaughter, came to live with him, to endeavour to make his home life happy. The old lady lived long enough to rejoice in being able to contribute to the happiness of the man whose career she had helped and watched over with loving interest from

his cradle; and on her death-bed she requested that her granddaughter (the writer of this book) should, if possible, remain, to carry on the work of caring for the welfare of one who was as dear to her as a son.

CHAPTER VI

THE *ILALA*—LAKE NYASSA

Between the years 1868 and 1875, about 350 steam-launches were built, varying in price from £140 to £2,000. Bad times were left behind, hard work remained.

One afternoon Yarrow, hurrying to the shipyard, met two gentlemen on the narrow bridge which leads to the Isle of Dogs. He was immediately struck by their appearance, and stopped to ask if he could be of any service to them on the Island, as they were evidently strangers. He felt instinctively that they had already been to make an inquiry at his works, and the answer to his question was: "We have just been to Yarrow and Hedley's to inquire if they can build us a very curious little steamer for a particular service. We saw Mr. Hedley himself, and he assured us that the boat was not practicable and that what we wanted could not be done." On hearing a few particulars, Yarrow asked the inquirers if they would return with him to the yard. One of them proved to be Captain Young of the British Navy, who had, at the request of the Nyassa Mission, obtained leave of absence in order to conduct their expedition.

Captain Young explained that the steamer was for Lake Nyassa and proceeded to describe his requirements. She was to be strong and seaworthy, for Dr. Livingstone had called Lake Nyassa the "Lake of

Storms," small, light, with a shallow draught, for she would have to steam up the Zambezi, which is full of rocks and sand-banks, capable of steaming against a swift current, and, above all, built in light sections, which could be disconnected and carried 60 miles through the forest when the rapids should be reached, each piece not weighing more than 50 lb., the maximum load for a native bearer.

Yarrow threw his whole heart into the design and construction of the *Ilala*. The boat was named after the sacred spot where Livingstone's heart was laid, at the weeping insistence of his native followers, when his body was embalmed and brought to Westminster Abbey. The name, and the history which it recalled, drew into this enterprise from its commencement the enthusiasm of the men, and very soon the *Ilala* was the pride of the yard.

It is impossible to pass over this small event without writing a few words about the wonderful expedition in which the *Ilala* took part. When Livingstone's friends wished to raise a memorial to him, they had as a guide certain letters, and advice obtained in his latter days, which made it clear in what form their admiration could best be testified. The Nyassa Mission was therefore created, to carry on the work (inspired and begun by him) of the suppression of the slave-trade in East Africa, and of the opening up and development of thousands of miles in this slave-hunting district.

David Livingstone was a Scot, born at Blantyre, near Glasgow, and £6,000 was quickly raised by his fellow-countrymen, who desired to carry out what was his dearest project at the time of his death.

The main feature of the Mission was its extremely



THE ILALA, THE FIRST STEAMER LAUNCHED ON LAKE NYASSA

LENGTH 55 FEET. BEAM 10 FEET

Drawing made by Mr. John Rennie in 1908, 33 years after she had been launched on the lake

practical basis. The country was to be explored, and rendered accessible. A healthy, and, if possible, a comfortable centre was to be formed on Lake Nyassa, with ready means of carefully planned access to the coast, as a station from which to carry out that fight against the evil which hitherto had held undisputed sway over thousands of miles of territory, and had baffled every previous effort to bring light and protection to the natives, viz. the slave-traffic. From this centre, authentic accounts of existing conditions were to be gathered and made public.

The first essential towards establishing a settlement on Lake Nyassa for the suppression of the slave trade was a suitable boat. The *Ilala* cost £1,600, and the story of her success is best told in Captain Young's book, called *The Mission to Nyassa*, from which several extracts are taken. "Lake Nyassa was Livingstone's own discovery. With its waterway from the coast, this was the position of all others, in his estimation, which should be gained at any cost, to annihilate the Portuguese and Arab slave trade of the East. In evidence of this, Livingstone had embarked nearly all his fortune in the unsuccessful endeavour to place a steamer on the lake as far back as 1861."

Yarrow had not previously come into contact with mission workers. He had looked upon them as somewhat visionary, heroic, and unpractical people, but his interest was thoroughly aroused when he heard the details of the proposed scheme. It was one of the earliest industrial Missions, was initiated by the Scottish practical mind, and, although no doubt there were fine preachers amongst the company, it appeared to Yarrow to consist of masons, mechanics, carpenters, a blacksmith, a seaman, and an excellent doctor—a

band of sinewy skilful Christian men ready for any emergency.

The *Ilala* measured 55 feet long, by 10 feet beam. She was provided with two boilers and a pair of inverted engines, was built in pieces, the plates being bolted and not riveted together, and no single piece weighed more than 50 lb. The boilers consisted of a number of circular sections bolted together, the point of this arrangement being that such rings could easily be rolled along the narrow paths cut through the forest. Captain Young constantly visited the yard, and gives in his book a well-worded tribute to Yarrow's keenness about the boat. "The commission," he writes, "to build a steamer was placed in the hands of Mr. Yarrow, and it is only due to him to state that from first to last the *Ilala* testified to his skill, and the attention which had been expended upon her." She was built in ten weeks, and was tried on the Thames, the fine old veteran African missionary, Dr. Moffat (father-in-law of Dr. Livingstone), being on board. Evidence of her strength and seaworthiness is given in the following paragraph quoted from the book, which paints the difficulties experienced by the little party on their voyage :

"The *Ilala* was put together at the mouth of the Zambezi. She steamed up that river, and then into the Shiré as far as Matiti, where she was taken to pieces ; from thence was carried through 60 miles of forest to avoid the cataracts ; was again bolted together on the Shiré, and steamed 100 miles up to the entrance of Lake Nyassa, at an elevation of 1,300 feet."

Of this journey Captain Young also wrote : " Our troubles now came upon us thick and fast. The

channel of the Zambezi was at its lowest, and the *Ilala* kept taking the ground perpetually. Wearisome work enough it was laying out the anchors, hauling and straining, to say nothing of occasionally discharging cargo to lighten her as we ploughed through and scraped over sand-banks every few miles." On entering the Shiré River: "If we hit on a channel that was navigable, it ended in a cul-de-sac, or led us back to the Zambezi; and at last, after two miserable days and nights, with very stormy weather, I sent a boat's crew away to try and find some natives to pilot us out of this abominable place. These they succeeded in finding, and so at last we had a chance of being extricated. To bring this about, we were taken back a long way, and had eventually to cut an opening through a wall of reeds and grass extending quite half a mile."

At Matiti, just below the Murchison Cataracts on the Shiré, the most difficult part of the venture was accomplished. Of the successful completion of this part of the journey, upon which so much depended, Captain Young wrote: "All the natives available were called in to carry the vessel, and having made known that labour was required, and that the price would be 6 yards of unbleached calico to each man for carrying a load not exceeding 50 lb. for 60 miles, we were delighted to find an extraordinary assemblage come pouring in from all parts." After this anxious and difficult journey was accomplished, Captain Young adds:—

"On arriving at the navigable point in the Shiré, above the cataracts, we had the extreme satisfaction of piecing together the *Ilala*, and seeing her once more afloat. It may be well imagined that during her reconstruction apprehensions would arise. What if

in one of those frightful ravines some of our poor faint carriers—wrung and bleeding with the heavy merciless sheets of steel—had cast his burden down, and hidden himself till the long file had passed? What if, tempted by the fine load of calico, the greed to become suddenly rich had done that which it has done for many a man, both black and white? What if, giddy and exhausted, the bearer of some important rod or gearing connected with the engine had missed his hold on the slippery rocks, and had accidentally lost his life, and, what would have been equally the case, the life of our steamer too? All these things passed and repassed through one's mind at every stage of our work, but the best answer to our fears was the sight of the *Ilala* resting at her moorings, tight as a bottle, and fit for anything. Yes, let this ever stand to the African credit: that 800 of these men worked, and worked desperately for us, free as air to come and go as they pleased, over a road which furnished at almost every yard an excuse for an accident, or a hiding-place for thief or deserter, but yet at the end of the 60 miles we had everything delivered up to us unmolested, untampered with, and unhurt, and every man merry and content with his well-earned wages of unbleached calico."

On October 12, 1875, the *Ilala* entered Nyassa, 1,400 miles from the sea, the very first steamer ever launched on an African lake. The arrival of the missionary ship, with her little band, full of enthusiasm over the great work before them, "was the birth hour of the greatest era in the history of Central Africa." Five slave dhows were on the lake, and one of them lowered its flag to the British flag flying at the mast-head of the Mission steamer.



THE *ADVENTURE*, BUILT BY VARROW & CO. FOR THE BRITISH GOVERNMENT TO PUT DOWN SLAVERY ON LAKE NYASSA. IN THE BACKGROUND IS THE LAST OF THE SLAVE DHOWS

LENGTH 75 FEET. BEAM $12\frac{1}{2}$ FEET

“God speed you,” said Captain Young, reverently, as they entered the Lake. “Amen,” responded his mates. Steam was then shut off, the engine ceased, and silence fell upon the party as they assembled on deck and engaged in Divine worship. With awed and rejoicing hearts they sang :

“All people that on earth do dwell,
Sing to the Lord with cheerful voice ;
Him serve with mirth, His praise forth tell,
Come ye before Him, and rejoice.”

Thirty-three years later the last dhow, full of slaves, was captured on Lake Nyassa, and slavery was practically abolished.

Other steamers built by Yarrow to assist in subduing the slave-trade on Lake Nyassa were the *Pioneer* and *Adventure*, gunboats sent in pieces by the Admiralty, to prevent the slaves being conveyed across the lake to the coast, which was the usual practice.

The *Dove*, a little paddle-boat, having a draught of 8 inches, was also ordered by the British Government from Yarrow. She navigated the Shiré between Lake Nyassa and the Zambezi with mails, maintaining communication with the coast after the Livingstonia Settlement was established. The good work done in the suppression of the slave trade, and the safer conditions assured for British enterprise, enabled the country to be rapidly developed.

In 1908 Mr. John Rennie visited Lake Nyassa, and made the sketches of the *Ilala* (then thirty-three years old) and the *Dove* which are reproduced here. Writing home, he said : “The lake has steamers and craft of many kinds and dimensions, but the little *Ilala*, the

first steam visitor, still holds her own as the smartest-looking craft afloat on the grand waters of Dr. Livingstone's lake."

It will be remembered that the body of Dr. Livingstone was brought home to London with heroic devotion by two faithful Africans, who encountered many difficulties in their journey from Central Africa to the coast at Quilimane. The faithful Suzi, one of these boys, after he had discharged his service of devotion and laid his beloved master to rest in Westminster Abbey, paid several visits in London before returning to his African home. One day he came to the Yarrow works to see some little missionary steamers then being built. The staff and all the men were greatly pleased with Suzi, who, after interesting himself for some hours amongst the boats and machines, went to have tea at a barge-builder's cottage close by. He was immediately impressed with the charms of the barge-builder's daughter, and, after sitting beside her for an hour, made her an offer of marriage. The girl refused the proposal, without hiding her amusement, and Suzi, in great wrath, told her that he was quite worthy of being her husband, for he had lunched with Queen Victoria, and she had not.

Colonel Halpin's launch had been the harbinger of success. From its completion, in 1868, dates the rise of Yarrow's shipbuilding industry, and from that time orders crowded into the little yard. Success, so eagerly sought, had come to stay. A wonderful reputation for good work and modern developments had been built up, and Yarrow's financial troubles disappeared to return no more. At last he found himself free to follow his own bent, to improve and develop those lines of marine engineering and shipbuilding which



THE DOVE ON THE SHIRE RIVER AT THE ENTRANCE TO LAKE NYASSA

LENGTH 60 FEET. BEAM 14 FEET. DRAFT 8 INCHES

From photograph taken by Mr. John Rennie in the year 1908

interested him, to carry out research—in short, to become a specialist.

No new development tempted him outside his chosen work. He devoted himself entirely to building light boats of high speed, and vessels for pioneer navigation in shallow rivers. Launches were sent to almost every part of the globe, and as there was no active competition, the firm obtained high prices. There were times of great tension regarding the success of undertakings, the attainment of high speeds, and the carrying out of innumerable experiments. Money was spent freely on experimental work, but Yarrow has often said that the position of the firm, after he sold his first boat, never gave him any serious anxiety. In spite of years of depressed trade, strikes, unforeseen changes, and the necessity of moving from one district to another to secure the most advantageous industrial conditions, the shipyard constantly increased in prosperity.

The financial history of Yarrow & Co. has been quickly told in these few pages, but the developments, improvements, inventions, the work done in connection with the building up of a section of our Navy, and the part Yarrow, amongst many others, bore in the scientific advancement of shipbuilding and engineering, contributing to the safety of our beloved shores, and to the comfort and convenience with which we visit other lands—in short, Yarrow's modest, but not unimportant, share in Naval progress—must now be briefly dealt with. It is proposed in the following chapters to describe some further contracts carried out during many years on the Thames, and more recently on the banks of the Clyde.

CHAPTER VII

THE TORPEDO

A very short account of the torpedo, from its earliest inception up to the important position which it now holds in the fleet of every naval power, may be of interest in this biography, because, although it would be out of place to describe in detail any one of its innumerable forms—controllable and uncontrollable, submarine mines, locomotive, etc.—when there is so much exhaustive material obtainable, still the work of the torpedo, and that of the boat which carries it, are so inseparably united, that it is impossible to give any description of vessels built at the Yarrow works without referring in some measure to the explosive which these vessels were destined to carry.

The torpedo was in actual, though crude, existence some 300 years before the torpedo-boat became an important feature in every Navy. The earliest torpedo of which we have a definite account dates back to the year 1585, and was invented by an Italian engineer, named Zambelli. It took the shape of a flat boat, filled with gunpowder, well packed, and ignited by a long sulphur match attached to a rope and clockwork. In the year 1587 a bridge over the River Scheldt at Antwerp was blown up by this device, the boat being allowed to drift with the tide, and exploding when it struck the bridge.

In each succeeding century certain developments

have been made in connection with torpedoes of every kind. Several attacks on British ships by drifting and floating torpedoes are recorded during the American War of Independence in 1777. Then came experiments of importance, made on the Seine by Fulton in 1797. Attempts were made, first by France, and then by Britain, to sink the enemy's warships by means of drifting torpedoes, and these are described in accounts of the war between 1801 and 1805.

In 1814 Fulton made further interesting trials with his torpedo, fired through the water by a submarine gun, which is stated to have penetrated a wooden hull at a distance of 15 feet. This appears to have been the earliest experiment of any note which resulted in actual damage to a vessel from a travelling torpedo.

Either the torpedo strikes the ship, or the ship strikes the torpedo. In the latter case, the torpedo is termed a "mine." It consists of a metal casing containing a powerful explosive, and generally several of these are anchored across the inlets to be protected. These "mines" are secured to suitable anchorages, and float at an approved depth below the surface of the water. They are placed at such a distance apart that a vessel cannot pass without coming into contact with one of them. Directly a ship touches the "mine," it explodes, or the same result can be effected by means of an electric spark controlled from the shore. This principle of defence is still used to protect our harbours, and particularly those which form naval stations.

The particular type of torpedo, however, which interests us is naturally that which is inseparable from the development of swift boats suitable for its operation, and it was not until the Civil War between the Northern

and Southern States of America, 1863, that the torpedo, which acts below the water, became united to the boat which sails on its surface, and thus came into practical use.

The torpedo which had the distinction of being the first to operate successfully from a boat was fixed at the end of a long pole called a "spar." It was fastened to a rowing boat, and the "spar," when rammed against the enemy's side, caused a violent explosion.

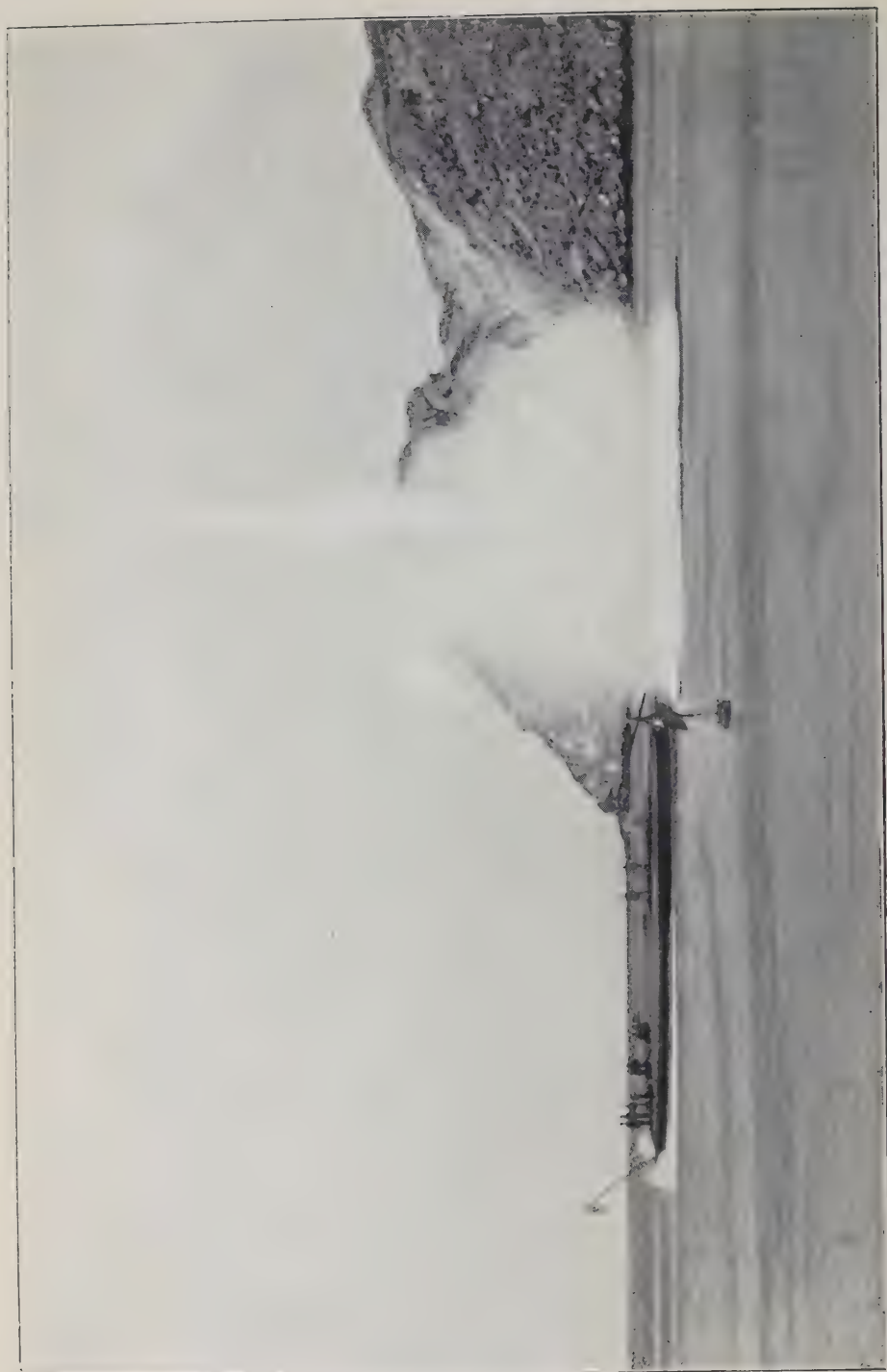
The spar itself consisted of a long pole of wood or hollow steel, which projected from the bow of the boat which carried it, a metal case containing the explosive being secured to the front end of the pole. Its disadvantage was that the explosion necessarily took place in close proximity to the torpedo-boat itself, this distance being determined by the length of the spar, which could not well exceed 40 feet.

In 1864, during the American Civil War, a great deal of pluck was displayed by both belligerents in the use of these primitive torpedoes. Official accounts are given, describing the sinking of large ships by spar torpedoes, and also by mines.

It is difficult to say who first suggested placing a spar torpedo upon a boat, but it is quite certain that in the American Civil War a naval officer on the Confederate side, Captain Hunter Davidson, engaged in defending a blockaded port, used with conspicuous success a torpedo fixed on the end of a pole attached to a small boat. These torpedo attacks were carried out by night, and generally everything was painted black, even the faces and hands of the attacking crew, so that the boat and those on board should escape observation so far as possible. At this period there



STEAM TORPEDO-BOAT BUILT FOR THE SPANISH GOVERNMENT FITTED WITH SPAR TORPEDO
AND DROPPING GEAR



THE SAME VESSEL WITH ENGINES GOING FULL SPEED ASTERN AT THE MOMENT OF THE
TORPEDO EXPLOSION

were no quick-firing guns, no defence nets, no search-lights ; and it was quite possible for a little boat bravely to ram its spar against a vessel, explode its torpedo, make a considerable hole in the side, and escape to a safe distance without annihilation. But the ordnance of a ship of the present day has rendered a spar torpedo obsolete, and the demand is naturally for a locomotive or self-moving torpedo, which can be discharged from a distant vessel.

Although these events were followed with some interest, sufficient credit was not given to the courageous use of the spar torpedo, which, needless to say, involved considerable danger to the attacking crew. But the successful manipulation of this weapon led to important developments, and from this time forward torpedo warfare was seriously considered.

At the conclusion of the American Civil War, Captain Hunter Davidson, who had left the United States on the collapse of the Confederate side, was engaged by the Argentine Government to organize a system of torpedo defence for that country. In 1875 he came to England to place orders for suitable launches propelled by steam, to carry the spar torpedo. It will be readily understood that the swiftest launches would be required, so that they might approach and retire from the object of attack at a speed which would minimize the risk of their own destruction. Thus, we find the torpedo and torpedo-boat united in an indissoluble bond ; and from the year 1873, when a torpedo was mounted by Yarrow on one of his fast launches, a concise history of their joint action until the present day, even if no other information were obtainable, might be gathered from the work done at the Yarrow yard.

Before leaving the side issue of torpedoes to return to our principal subject, i.e. the construction of Yarrow boats, a few words must be written about the "Whitehead" torpedo, the culmination of torpedo inventions.

Since the year 1877, the "Whitehead," named after the inventor, who brought it into practical use, has entirely superseded the "spar," and forms part of the armament of nearly every warship.

A very short and superficial history of this interesting invention is all that can be given here.

Mr. Whitehead at first carefully guarded his secret, preferring to do this rather than take out patents which the various Governments would be able to adopt without coming to terms with him for the use of his invention. In 1870 this weapon was brought before the Admiralty, and, the trials being deemed satisfactory, the secret and right of manufacture were purchased by the British Government in 1871 for £15,000.

At the introduction of this torpedo, there were many conflicting opinions and theories as to its construction, and only a shadowy notion of the actual arrangement of the interior became common property outside the works of those Governments which had purchased the secret.

The "Whitehead" is technically described as belonging to the locomotive class of torpedo, that is to say, it carries within itself the means of its own propulsion; it can be regulated to run at any depth desired below the surface of the water, and when once its course has been determined, it will continue to run in the same direction. It consists of a cigar-shaped steel case, the forward part being filled with an explosive, so that, when it comes in contact with the side of the vessel

attacked, an explosion will occur. Owing to the incompressibility of the water which surrounds it, the path of least resistance for the gases which are generated by the explosion is obtained by bursting through the skin of the vessel attacked, thus allowing the water to enter. The advantage of this form of torpedo over its predecessor (the "spar") is clearly that the boat which carries it does not come in close proximity to the enemy vessel, as the "Whitehead" can be discharged at a distance. The central portion of the case contains compressed air at a very high pressure; this compressed air is the means of developing the power necessary for propelling the torpedo after it has been discharged. The after-part of the torpedo is fitted with a small engine, which gives motion to the screws; these act upon the water at the stern and propel the "Whitehead."

The great difficulty at first was to ensure that the torpedo would travel continuously in one direction, and not be diverted from that course by outside influences.

Exhaustive experiments carried out by Mr. Whitehead at Fiume produced the apparatus which is now universally fitted to the torpedo, and to which its success is due. It is based on the principle that a body revolving on a free axis tends to preserve its plane of rotation; for example, an ordinary top, when spun at high velocity, will retain its vertical position so long as it continues spinning, and will resist any outside pressure tending to force it from revolving in the plane which it originally took up. A revolving wheel, commonly called a gyroscope, is situated inside the torpedo, and is connected to the rudder in such a manner that, if from any outside influence the course of the

torpedo is diverted from its original direction, the gyroscope will act upon the rudder, with the result that the torpedo will be forced to resume the same direction which it originally had when discharged. So long, therefore, as the gyroscope is revolving at high velocity, the torpedo, in spite of deviations from its original course, due to waves or other outside influences, will maintain the original direction given to it.

It should here be stated that the specific gravity of the "Whitehead" is as nearly as possible that of sea water, and there are placed at its stern horizontal rudders arranged in such a way that the torpedo will run its course at any predetermined depth. These rudders, which regulate the depth maintained by the torpedo, are actuated upon through suitable mechanism by the pressure of the head of water over the torpedo, the depth below the surface being subject to adjustment as may be desired, dependent upon the vessel to be attacked.

For discharging the "Whitehead" torpedo, boats were at first provided with one or two launching tubes in the bow. In this case, the direction to be given to the torpedo was determined by the direction of the boat itself.

An alternative arrangement, and one now universally adopted, is to discharge the torpedoes from tubes which are swivelled over the side of the vessel, so that any direction to the "Whitehead" can be given, irrespective of the course of the ship from which it is discharged.

Among the different systems devised for discharging the torpedoes is one introduced by Yarrow, which consists of two or more tubes mounted on a turn-table, the direction of the tubes slightly diverging from one another. The turn-table can be revolved and the

tubes pointed at any object. As it is clearly difficult to aim at a ship in motion with a torpedo which has to travel through the water when the speed and direction of that ship are unknown, the chance of a hit would be much increased if two or more torpedoes having slightly diverging courses were fired simultaneously, in the same way that a bird in flight is more likely to be killed by a number of small shots discharged from a gun than if only one shot is fired.

The success of the "Whitehead" was the means of giving a great impulse to the construction of the class of vessel specially adapted for carrying this new form of armament.

As improvements have taken place, the speed of the "Whitehead" and its range have been gradually increased from 6 knots an hour up to the present maximum speed of 40 knots an hour, and its range has been augmented by a supply of heated compressed air, which is now sufficient to enable the torpedo to make a run of 6,000 yards at a speed of 35 knots, or 14,500 yards, if set for 25 knots.

CHAPTER VIII

NOTABLE HIGH-SPEED BOATS, 1875-79

The rapid changes during the middle of last century in the construction of ships, and in all methods of attack and defence, were so remarkable that it was difficult to foresee what form naval warfare would take.

Within half a century of the close of the memorable struggle between Britain and France, with its heroic victories by Nelson and his fleet, with its hand-to-hand contests, which read now almost like fairy tales, it appeared that ships were no longer to be of wood with many decks, but of steel and iron. The change is admirably depicted by Sleeman :—

“Swords were suddenly not required for sailors, but mechanical knowledge of guns which could be fired at a vessel almost out of sight became an essential part of naval education, and the amazed student who looked into the future wondered whether naval practice and warfare might, for all junior officers, become devoid of initiative and opportunity for individual heroism. Then the torpedo came upon the horizon. The young sailor would be needed to drive his small boat within a few feet of the enemy, to voluntarily cause a thunderous explosion which threatened to blow up and to sink both friend and foe, and the honours of war might again, as in former years, fall to the youngest officers.”

Returning from torpedo digressions to continue the constructive account of Yarrow's life and work, we

must now consider some of the vessels built at Poplar.

Governments were not slow to realize the important part which the torpedo was destined to play both in defence and attack, and all the Powers, those with small navies as well as those with large ones, determined to acquire the fastest and handiest boats which could be devised at that time for this special service. Every advance in design and construction was eagerly grasped at by one Government after another, and in an incredibly short time the torpedo-boat, with each succeeding improvement as it arose, became adopted. At first, the fast boat was only designed to carry one or more spar torpedoes; by degrees, however, these torpedo-boats grew larger, and became ultimately capable of carrying several "Whiteheads," as well as a powerful gun armament. They were then known as "Destroyers."

The first launches specially designed by Yarrow to carry torpedoes, those ordered by the Argentine Government, measured 55 feet in length. They were neither larger nor faster than some of the pleasure launches already built by the firm, but embodied qualities necessary to fit them for the special service in view. The next torpedo-boat ordered was for the Dutch Government, and measured 75 feet.

As an illustration of the extent to which these high-speed vessels were demanded by foreign Powers, it is interesting to find that between the years 1877 and 1879 orders were received by the firm from the Argentine, Dutch, French, Russian, Greek, Spanish, Austrian, Italian, and Chilian Governments. The demand came with unexpected rapidity, and was such that Yarrow had at one time three naval attachés in the waiting-room, each anxious to place an order for his Govern-

ment at the firm's own price, with only a brief description of the boat proposed, on a sheet of paper—very different from the present Admiralty practice, which, as is well known, involves a specification bound up in something like the form of a family Bible !

It is now proposed to give a description at some length of six types of vessels which are called "Notable High-Speed Boats," because each one embodies some definite advance in torpedo-boat construction.

Torpedo-boat No. 425, called the "Admiralty Sample Boat," we shall refer to as the "First Notable High-Speed Boat." It formed the starting-point of Yarrow's world-wide reputation.

This sample boat, ordered by the Admiralty, was looked upon, to some extent, as an experiment. A similar order was given to any firm which was considered to offer a reasonable prospect of carrying out the work successfully ; the guaranteed speed required was 18 knots, and a penalty was imposed for any failure in this condition. It is not remembered that there was any suggestion of a premium for speed of more than 18 knots, as at that time this was not considered within the bounds of possibility. Several shipbuilders entered into the competition, but it must be recorded that the torpedo-boat built in Yarrow's yard far exceeded all others in speed, realizing 21·9 knots, approximately 3 knots ahead of the highest speed attained by any competitive vessel tested under the same conditions. This boat was considered a great marvel, and a picture of it is shown. One interesting feature will be noticed. She had no funnel,

and was so low in the water that she was scarcely discernible at a distance.

The abnormal speed of this special boat was mainly due to some interesting experiments, carried out by the firm, with screw propellers. At the time it was generally believed that for this size of vessel a propeller 5 feet 6 inches in diameter, with narrow blades, gave the highest efficiency. It was also thought that, within a certain limit, the larger the propeller and the greater the area of water acted upon, the less the slip and the better the result. With this in view, Yarrow constructed a propeller 12 inches larger in diameter than was at the time considered suitable. Contrary to expectation, it was found on trial that the boat lost in speed by the change. This led to the simple conclusion that an improved result might possibly be obtained by adopting the opposite course, and having a propeller smaller than the one considered the best. A very exhaustive series of experiments with propellers was carried out, perhaps the most valuable which had been attempted at that time. Twenty-five propellers were made, of various sizes, having different pitches and different areas, with two and with three blades. As a result of these experiments, a propeller of only 4 feet 4 inches in diameter, with three blades, was adopted, and although the slip of the screw was increased, the speed was greatly improved.

In order to get the maximum result on the trials of these early boats, when there was a constant demand on the part of naval authorities for increasing speeds, many superficial aids were resorted to by shipbuilders. For example, a boat before trial would be pulled up on the blocks, and her bottom polished with blacklead and old ale, until the men declared they could see to

shave themselves in the polished surface as well as in a looking-glass. Yarrow was very distrustful of the old ale having anything to do with the speed of the boat, but it is not impossible to imagine that it may have had some indirect effect ; at any rate, the men engaged in the polishing operation always declared that it was quite as indispensable to a good surface as the black-lead. It need hardly be added that the two ingredients were, by special request, served separately !

It will be remembered by students of modern history that in the early part of 1877 the political horizon was clouded by disagreements over many complicated questions in Eastern Europe ; Russia, Turkey, Austria, Rumania, Bulgaria, Bosnia, Herzegovina, and Servia were all more or less involved, and grave fear was entertained that war might break out. During the early stage of the disagreements between Russia and Turkey, which afterwards gave rise to difficulties between Russia and ourselves, the Russian Government determined upon having a hundred torpedo-boats built, and commissioned Captain Kasy—the distinguished head of the Baltic Shipbuilding Works, Petrograd—to make arrangements with a British firm of high repute to supply designs of torpedo-boats, it being stipulated that these vessels should have a speed of 18 knots, and be of such a size that they could be transported from the Baltic to the Black Sea by rail. The dimensions determined upon were 75 feet in length, by 10 feet beam.

Captain Kasy came to Poplar, and arranged that Yarrow should give him the working drawings of both hull and machinery, and also supply as many sets of engines and boilers as could be constructed in his works



THE FIRST TORPEDO-BOAT TO REALIZE A SPEED OF 21·9 KNOTS AN HOUR STEAMING PAST GREENWICH HOSPITAL. IT SHOULD BE OBSERVED THERE IS NO FUNNEL, THE SMOKE PASSING OUT OF THE SIDES. THE OBJECT BEING TO REDUCE ITS VISIBILITY

and dispatched before navigation in the Baltic was closed for the winter. The drawings of the vessels were to be used by the Russian shipbuilders, the machinery designs were to serve as a guide to Continental engineers, and everything was to proceed with the utmost haste. The hulls were constructed during the winter months, work being continued day and night, for which purpose very complete electric light installations were fitted up in the Russian yards. The machinery was supplied mainly by German firms, as the Russian Government did not wish to place further orders in Great Britain, because, in the event of hostilities, nothing forming an integral part of a war-vessel would be allowed to leave this country for Russia.

It should be stated that before these designs were actually supplied, the British Admiralty were informed by Yarrow of his contract with the Russian authorities.

Simultaneously with the determination of the Russian Government to put in hand the torpedo-boats, Captain Goulaeff, a member of the Technical Committee, acting under instructions from Admiral Popoff, placed an order for two torpedo-boats with Yarrow. These little vessels were paid for by voluntary subscriptions from the Russian nation, and were ordered without reference to the Russian Admiralty. They were to be of larger size than the 100 boats previously referred to, as they were not intended for transport overland by rail. When these two boats were approaching completion, and the Russian captains and crews had arrived in this country to take possession and to navigate them to the Black Sea, the relations between Great Britain and Russia became seriously

strained over the Turkish question. At that time it seemed more than probable war would result, because every move which the Russian army made towards Constantinople excited on the part of Great Britain a fear that this port, for many years coveted by Russia, might at last fall into her hands.

It must be called to mind that on June 27, 1877, a Russian army had crossed the Danube; and the siege by the Russians of the powerful Turkish stronghold of Plevna followed. Whilst our critics were still proclaiming that the situation need give no alarm to the British, Plevna surrendered, on December 10, 1878, thus leaving the road to Constantinople clear. Shortly afterwards the Turks were compelled to sign an armistice, but the report followed that the Russians were pushing on towards Constantinople. This rumour proved to be unfounded, but the country remained in a state of agitation and under the shadow of war until the Berlin Conference in June, 1878.

Amidst so much national excitement, from which grave fears of Russia were not absent, the two torpedo-boats, constructed at Poplar for Russia, could not leave our shores. This was a very trifling affair in view of the tremendous tension through which the country was passing; but as this is not a political history, it must be recorded that it was a serious matter at the Yarrow yard, and required grave consideration. "No boats for Russia must leave the Thames," was the edict issued. Yarrow immediately gave notice to the Government that it was impossible for him to take the responsibility of the charge of two completed torpedo-boats, because the Russian officers and crews were on the spot, and at any minute might seize

the vessels and leave the Thames. Whereupon the Government placed a custom-house officer on board each boat, and moored them to the shore by powerful anchors.

As these vessels were not allowed to leave the country, the return of the instalments paid on account was naturally demanded by the Russians. This fact was represented to the Admiralty, who stated that they would be glad to acquire the boats. Yarrow offered them, very naturally, at the price the Russians had agreed to pay, which price was declared by the Admiralty to be excessive, and the purchase refused. The following morning Yarrow called at Whitehall, and said he was prepared to sell the boats for whatever sum Messrs. Thornycroft were receiving from our Government for vessels recently ordered of a similar size. The Admiralty stipulated for a very heavy penalty if the speed should fall below the contract speed of Thornycroft's boats of 18 knots. This was agreed to by Yarrow, conditionally upon a similar premium for greater speed being promised. The authorities at the time did not believe more than 18 knots could be obtained, and readily concurred. The official trials took place, and, to the great surprise of everybody, speeds of 20·8 knots and 20·6 knots were obtained. Owing to the premiums earned, the Admiralty paid a sum of £1,900 more than the price originally refused by them as being an excessive overcharge.

On the completion of the 100 torpedo-boats built in Russia from Yarrow's designs, great trouble was experienced through the leakage of the tubes in the locomotive boilers, a defect which was universal at that period of boiler construction. Men were scalded

to death, and naturally stokers refused to work the boilers to anything approaching the contemplated power, with the result that the speed of the vessels and their utility were greatly diminished. The Russian Government telegraphed to Yarrow, telling him the trouble they were in, and asking what remedy he could propose.

This was the period in steamship construction when forced draught was first brought into use. When we speak of "forced draught," we mean urging the fires in the furnaces of the boilers by fans, to what at the time was considered an abnormal extent, so as to burn the greatest amount of fuel, and thereby obtain the maximum quantity of steam. Before this method was employed the union between the boiler tubes and the plates into which they were fitted was sufficiently good to stand any strain to which they might be put, but with the greater heat and increased generation of steam produced by the new high rate of combustion, the connection between the tubes and plates gave way.

In consequence of this somewhat unexpected difficulty, all marine engineers using forced draught were at their wits' end. The problem how to avoid this risk to the stokers was taxing the brain of every one engaged in this class of work, and the endeavour to find a solution naturally preyed on Yarrow's mind. Now it may happen that whatever is uppermost in one's thoughts at the time of retiring to rest forms the subject of one's dreams. After pondering over this boiler trouble one evening, Yarrow dreamed of a device by which the difficulty could be overcome. On waking in the night, he got up, made a sketch of the plan which had become clear to him, and then slept again.

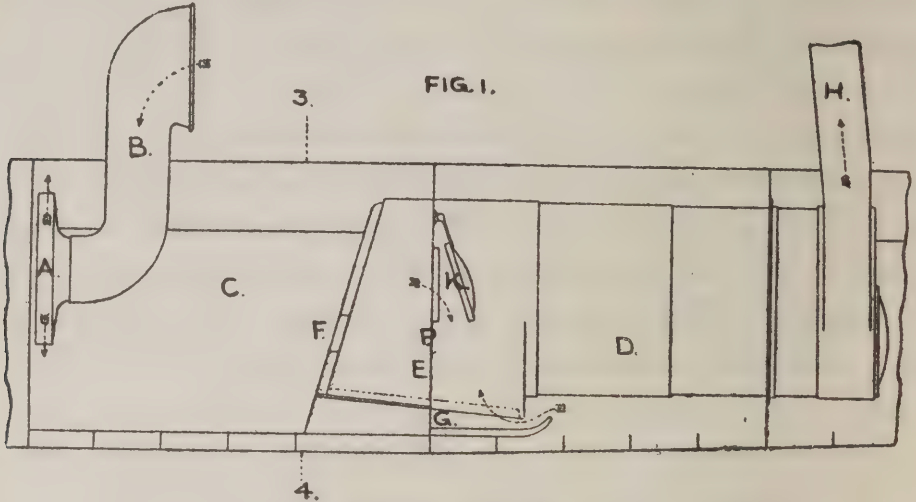
In the morning he realized that the dream had brought with it a complete solution of the problem. A telegram was sent the same day to the Russian Government stating that a device had been discovered which would in future save the stokers from risk of accident, and that the secret might be purchased for £2,000. To this the Russians replied that they would accept the proposal, would pay £1,000 before the invention was explained to them, on the strength of Yarrow's assurance that it would prove successful ; and that the other £1,000 would be paid when they were satisfied of its efficiency. The remedy gave perfect satisfaction to the Russian Government, and the second £1,000 was paid.

Before telegraphing to Petrograd that the difficulty in connection with the leakage of boiler tubes had been overcome, Yarrow called at the Admiralty and informed the authorities of all that was passing.

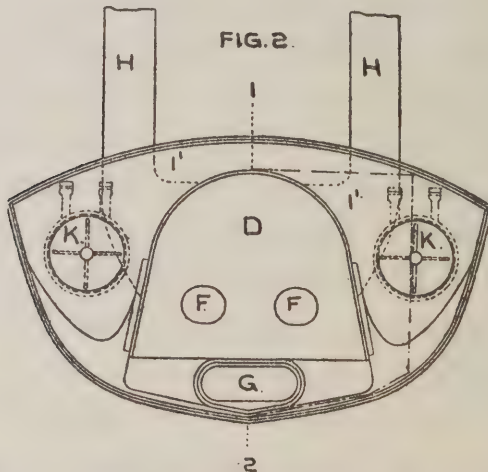
The plan for insuring the safety of the stokers consisted in interposing a light air valve between the stokehold and the fire through which the air had to pass before gaining access to the furnace. This valve opened freely in one direction to admit the current of air on its way from the stokehold to the fire, but closed instantly on any rush of steam or flame in the opposite direction, which would necessarily occur should the tubes suddenly leak ; the outlet for the steam and flame up the funnel being insufficient to allow ample passage for the extra volume of gases thus generated, and the only other outlet possible being into the stokehold where the men were stationed, unless something was interposed to prevent it passing that way.

To make the device clear, we refer to *Figs. 1 and 2*, taken from the patent specification,

A is a fan driven by steam, which draws in the air through a pipe *B*, and directs the same into the stokehold *C*. *D* is the boiler, the furnace being inside, with firedoors *F*, *F* and ashpan *G*. *H*, *H* are the chimneys.



A.D. 1878. MARCH 4. N^o 872.
YARROW'S SPECIFICATION.



SECTION THROUGH A TORPEDO-BOAT, SHOWING YARROW'S PATENT FOR
PROTECTING STOKERS.

There is a bulkhead across the ship which is interposed between the fan *A* and the furnace. In this bulkhead there are openings which are fitted with light valves, *K*, arranged in such a manner as to be opened by the

rush of air passing as indicated by the arrows, but instantly closing if a current comes in the opposite direction. Thus, if a tube were to burst, the flame and hot gases, having a tendency to pass in the opposite direction to the usual current of air coming from the fan, would pass into the stokehold, were it not for the hinged valves *K, K*, which instantly close and protect the stokers from being burnt.

This device in some form is now universally adopted in connection with forced draught. The importance of it, and its results, can, perhaps, only be appreciated by those who passed through the terrible ordeal of boiler trials during that particular period.

Three or four years after these events Captain Kasy paid Yarrow another visit. When he entered the office, Yarrow appeared startled by his changed appearance, and Captain Kasy, who formerly had jet black hair, said at once, "I suppose you are looking at my white hairs." Yarrow, out of courtesy, denied it, although it was actually this change which had attracted his attention. Captain Kasy remarked that "each white hair represented a leaky boiler tube."

The possibility of European complications during the year 1878 determined the British Government to hold a review of the Fleet in the Solent, and requested Yarrow to send the two torpedo-boats originally built for the Russians, but ultimately purchased by our Government, so that they might take part in the manœuvres.

It may be here mentioned that vessels of this type, and of such light construction, had never before been

sent to sea, and it was quite uncertain whether the thin plating would stand the strain of rough weather. In fact, these two boats became a source of ridicule in the House of Commons, the Government being criticized for entertaining the purchase of vessels built with such light plating, the thickness of which was in parts less than one-eighth of an inch. In the course of a speech, one member expressed a fear that if anybody should jump on the bottom of the boat, he would probably burst through it into the sea.

As the request of the Admiralty to have the boats sent round to take part in the Naval Review arrived very late, it was arranged that they should leave Poplar the same evening for Portsmouth. Yarrow advised every one to have a good meal before starting, as, he said, they could not tell when they would get another. He himself went on board at Poplar, accompanied by his wife, with the intention of landing at Gravesend. But the weather became so rough that it went against the grain with him to tell the crew to proceed whilst he went ashore, for it was known to every one that there was an element of risk in the voyage, the boats being then of such an experimental character, consequently Yarrow and his wife decided to remain on board. After a somewhat perilous trip, they got into smooth water at break of day, off Sheerness, every one being in a half-drowned condition. Admiral Brandreth, then Superintendent of the Dockyard, took pity on the exhausted crew, had them brought ashore, and set them up with a good meal. The weather cleared towards the afternoon, and the voyage was continued as far as Margate, where they anchored, in hope of a good night's rest in smooth water. In the middle of the night, however, the wind changed to the north-east,

and began blowing hard. To remain in an open roadstead with a wind blowing towards the shore was clearly dangerous, so a fresh start was made, and the boats arrived in the midst of the Fleet off Portsmouth the next day about noon. Great enthusiasm was evinced by the crews of the various men-of-war on the arrival of these little vessels in their midst. It happened to be a Sunday, the Church service was just over, and the bands were playing those cheerful strains from H.M.S. *Pinafore* which referred to Mr. Smith, the popular First Lord of the Admiralty, who was then on board one of the ironclads.

The voyage from Margate to Portsmouth through such boisterous weather was of great value as an experimental test, proving the seaworthiness of these little vessels. Their lightly constructed hulls gave evidence of very great elasticity, bending considerably under the strain to which they were subjected, alternately being supported on a wave amidships, and on waves at each end. Yarrow, at one point in the voyage, advised the pilot, who was in the centre of the vessel, to come either to one end or the other, because if she broke in two, he said, it would occur just where the pilot was sitting, and it would prove uncomfortable for him to find one part of his body in the bow of the ship, and the other part in the stern.

As an illustration of the care with which the Admiralty sanction the expenditure of public money, it is interesting to note that when the firm's account for the expenses connected with sending the two vessels to take part in the review was received at Whitehall, "their Lordships" returned the invoice with the request that a deduction should be made corresponding

to the additional expense involved in Mrs. Yarrow having accompanied the two boats. They had heard of her presence, they stated, and considered it was not necessary for successful navigation.

The Times, in describing the Review on August 14, 1878, said :—

“ One of the features of the Review was the performance of two long double-funnel torpedo-boats, built by Yarrow, which have realized the extraordinary speed of 21 knots. The manner in which these malevolent-looking craft rushed up and down the lines and round the ships was the astonishment of all beholders.”

These two little vessels were probably the first cause of Yarrow's name being brought prominently before the public. The Naval Review took place in somewhat boisterous weather, too rough for the safety of small craft, and consequently there was a fairly clear course between the lines of the men-of-war, for the boats to show their speed.

Prior to Her Majesty Queen Victoria starting from Osborne to inspect the fleet, the Yarrow boats proceeded from Portsmouth to Cowes, and accompanied the royal yacht, one on each side, as she passed up and down the lines of vessels. Although it was afterwards understood that Yarrow was guilty of a serious breach of etiquette in escorting the Queen without command to do so, nevertheless Her Majesty the same evening sent a special message to him, through the Admiral of the Fleet, expressing the great interest she had taken in these two vessels ; indeed, Her Majesty stated that they had interested her more than anything else at the Review.

A few days afterwards, during the regatta week at

Cowes, King Edward VII, then Prince of Wales, sent word through Lord Charles Beresford that he would much like to take a cruise on one of the torpedo boats, and his trip was referred to as follows in *The Times*, dated August 20, 1878 :—

“Yesterday morning some torpedo experiments, illustrating the method and effect of torpedo warfare, were conducted by the officers of the torpedo school on board the *Vernon*, in the presence of the Queen, the King and Queen of Denmark, and the Prince and Princess of Wales. . . . In the afternoon the Prince of Wales, accompanied by Lord Charles Beresford, went on board one of Yarrow's torpedo-boats, which were the wonders of the Spithead Review last week, and was driven at express speed. These torpedo-boats were originally built for the Russian Government, and were intended to carry spar torpedoes, a couple of funnels being placed one on each side of the middle line, so as to afford a clear space between them for working the spars. . . . When driven at the maximum speed, the boats have realized 21 knots. . . . The Prince of Wales took the greatest interest in the runs, going himself down into the somewhat cramped engine-room, and braving with every appearance of real enjoyment the showers of spray that were thrown up by the vessel when driven at full speed against wind and tide. One of the peculiarities of these boats is the application of a patent for protecting the stokers against the danger of scalding by sudden leakage of the boiler tubes, the complete success of which was practically demonstrated during the first official trial, when a tube gave way without anyone being injured. The trips were personally conducted by Mr. Yarrow, to whom, on leaving, His Royal Highness expressed the pleasure he felt in being driven so rapidly through the water, at the same time warmly congratulating him on the success achieved by his firm.”

Two torpedo-boats were built for the Austrian Government in 1879. These were tried, accepted, and paid for in London, steamed out to Pola, and were

considered in every way highly successful, exceeding considerably the contract speed. They took part in the autumn manœuvres in the Mediterranean, but on their return to the dockyard some of the riveting was found defective. Official complaint was received on the subject, and the same day Yarrow dispatched two members of his staff to inspect the vessels at Pola. There was, no doubt, some inferior work in the hulls, and the firm at once telegraphed to the Minister of Marine in Vienna to the effect that after inspection they recognized that some of the riveting was defective, and although, according to contract, no legal responsibility rested with the firm after the delivery of the boats into Austrian hands on the Thames, they did not wish to avail themselves of this condition, and desired that His Excellency would have whatever he deemed necessary carried out, at the firm's expense. Yarrow instructed his representatives on their way home to call on Baron Sterneck, Minister of Marine, and convey his regret at what had occurred. The Baron expressed himself as extremely gratified at the way in which the firm had acted, and to show his appreciation, he requested them to put in hand two more similar torpedo-boats, but added that they should "look out" that the riveting was perfect.

CHAPTER IX

NOTABLE HIGH-SPEED BOATS, 1880-94

The second notable boat was the *Batoom*. With her a new era may be said to have commenced in this class of construction, inasmuch as she was the first really sea-going craft of the torpedo-boat type.

In 1880 the Russians were particularly anxious to have torpedo boats of larger size than those previously designed ; vessels which would be safe in any weather at sea, and with sufficient cabin accommodation for the crew to live on board for lengthened periods. It was decided to place the order for such a craft in Yarrow's hands. This was to be a sample boat, and the dimensions determined upon were 100 feet in length by 12 feet 6 inches beam. She was named the *Batoom*, attained a speed of 22 knots, and made the voyage safely from the Thames to the Black Sea.

Other Governments, being impressed by her sea-going qualities, at once ordered duplicates, many of which crossed the Atlantic.

In the year 1881 strained relations existed between Greece and Turkey, rendering it essential for the Greeks immediately to increase their navy. One dark winter evening, eight Greeks came to the Poplar yard. These gentlemen, with Admiral Tombasis, the chief of the Naval Commission, had been sent over by their Government to order six torpedo-boats. The matter was explained to Yarrow as being very urgent, and,

after the price and size of the vessels had been settled, a heavy penalty for delay in completion was insisted upon. To this Yarrow agreed, on condition that a premium equivalent to the proposed fine should be paid for early delivery. This the Greek Commission concurred in. Yarrow managed to finish the boats several weeks before the contract time, and so earned a premium of £12,500.

Admiral Tombasis, who lived in meagre apartments in order to save his country's money, was greatly troubled at this heavy claim upon the Greek resources, fearing that his countrymen might think that some of the money found its way into his pocket. Every effort was made by him and by other Greek representatives to get the claim diminished or abandoned, but Yarrow remained obdurate. It happened that in a previous contract with the Greek Government a heavy penalty for late delivery had been enforced, and he considered he was justified in following this example, which should serve as a precedent. On receiving payment in full, however, he called the same day on Admiral Tombasis at his lodging, and returned him a cheque for £3,500, stating that although he could not admit his Government's right to repudiate the claim, yet he wished to show his hearty appreciation of the Admiral's patriotism by returning this sum. The Admiral, who was a little man, put his arms round Yarrow, and embraced him in a spontaneous outburst of affection.

In 1885, when two changes of Government took place within one year, Mr. W. H. Smith, in criticizing the Navy estimates, dwelt on the neglect of the Admiralty to push on the building of torpedo-boats. A war, even

a sudden war, he thought was not impossible, and he believed that the Navy was not adequately equipped for such an emergency. In the House of Lords, Lord Salisbury moved a vote of censure in respect of the Government's deplorable failure in the matter of the Sudan Expedition. But whilst the vote of censure was still under discussion, other matters arose by which the situation was further complicated.

Trouble developed on the Russo-Afghan frontier which seemed to imply a breach of faith with us on the part of Russia. An order was given by the Admiralty to Yarrow for twenty-four torpedo-boats of 125 feet in length. Long before these boats, so hastily ordered, were completed, the boundary trouble between Russia and Afghanistan, which involved the honour of our country, had passed away.

Although these boats were not called into use in connection with any historic struggle with Russia, one of their number, No. 79, is of definite interest to engineers on account of being fitted with triple-expansion engines, for the use of which Yarrow had obtained Admiralty permission. At the trials the speed attained by No. 79 exceeded that of the other boats (fitted with the ordinary compound engines) by $2\frac{3}{4}$ knots, and in consequence of its success this boat was placed under the command of Prince George, now our King.

It must be understood that in a compound engine the steam passes into what is termed the high-pressure cylinder, which is in direct communication with the boiler, and, after having done a certain amount of work in that cylinder, it passes on to do further work in a second cylinder, and is then exhausted into the condenser.

With the triple-expansion engine it goes through three stages instead of two, passing from the high-pressure cylinder to the middle-pressure cylinder, and then on to what is termed the low-pressure cylinder, thus making three expansions instead of two. After having developed energy in each cylinder, it passes into the condenser.

The principal gain of the triple over the compound engine is due to the greater range of expansion which thus takes place.

“Mr. Yarrow, will you tell me in the strictest confidence,” said the First Lord of the Admiralty one day. “Is there any bribery or corruption in our department?” “Yes, indeed there is,” replied Yarrow. “You don’t say so,” said the First Lord. “Pray tell me, as a special favour, where it exists?” “I always give your messenger a Christmas box, and I have a shrewd suspicion that when I call, my card is received earlier than that of some other visitors. That is the limit of any form of bribery which, so far as my knowledge goes, takes place at the Admiralty.”

Yarrow often expressed his admiration for the members of the Admiralty staff, and declared that the country should be proud of the high standard of honour and integrity in this department of the Government, in spite of the fact that they are very inadequately paid for their services. But Admiralty work, although a necessity to leading firms, and eagerly sought for the sake of prestige, is, unfortunately, frequently carried out with financial loss.

In the years 1887 and 1888 the firm constructed for the British Admiralty a number of torpedo-boats



TORPEDO BOAT No. 79, COMMANDED BY PRINCE GEORGE

LENGTH 125 FEET. BEAM 12½ FEET. SPEED 22¼ KNOTS



SECOND-CLASS TORPEDO BOAT
LENGTH 60 FEET. BEAM 9 FEET. SPEED $17\frac{1}{2}$ KNOTS



THE *HORNET*
LENGTH 180 FEET. BEAM 18 FEET. SPEED 27'3 KNOTS

termed "Second Class," this description referring not to the quality of the boat, but to the size. They were to serve as tenders to the large ships, and were hoisted up by davits. An essential condition in the design was to keep the size and weight within such limits as would enable them to be readily lifted by the ordinary appliances available on large vessels. The dimensions were 60 feet in length by 9 feet beam, which secured sufficient sea-going qualities; the lifting weight was about 12 tons, their speed 17 to 18 knots. In these little boats the torpedoes were carried, in some cases in cradles, one on each side, and, when lowered into the water, propelled themselves in a course parallel to the vessel itself. In other cases a torpedo was carried in a tube at the stern, arranged to turn round on a central pivot, so as to cover a large range.

An interesting second-class torpedo-boat was constructed by the Yarrow firm for the French Government in 1892. The authorities in Paris invited tenders for a special type, which it was desired should serve as a tender to the battleships in the French Navy. The Government stipulated that the length should be limited to 60 feet, but they demanded a speed of over 20 knots, with a lifting weight of under 10 tons. The French constructors did not submit any proposal, stating that the conditions could not be complied with. The Yarrow firm offered to carry out the requirements of the Government, suggesting that the hull be built of aluminium, which is lighter than steel. After the contract was given, the French firms were somewhat vexed at its being placed out of the country, and represented to the Minister that if they had been told that aluminium would have been accepted, they

could have conformed to the conditions demanded. But the authorities pointed out that it was open to every firm to have proposed aluminium, as no stipulation had been laid down as to what material should be used for the hull.

The order for this sample boat was successfully completed, but, on being taken over by the French authorities, it was left in Cherbourg Harbour, and the hull began to deteriorate, which was due to one of two causes.

For some time she was moored in the dock alongside a wooden vessel, the bottom of which was coppered. The vessels being in salt water, a galvanic action may have taken place between the two boats, and the aluminium hull would naturally be the one attacked.

Another explanation of the trouble has been given. It is well known to those who travel that, in continental villages, washing operations are generally carried on by the peasant women in running water, and a considerable quantity of soap is necessary. It appears that a stream used in this way flowed into the dockyard where this little boat was moored, and consequently the water became alkaline. An alkali will attack aluminium, and, if sufficient washing took place in the stream, it might account for the deterioration of the boat's hull.

Had the French authorities taken the precaution to have the boat lifted out of the water and properly painted, as would have been the case had she been built of steel, no such deterioration would have occurred. Unfortunately, this mischance brought the use of aluminium as a boat-building material into disrepute.

The third notable boat was the *Hornet*.

In the spring of 1892 Yarrow called at the Admiralty to place some facts before Admiral Sir John Fisher, then Controller of the Navy. He stated that he had visited some of the French shipyards, and had there seen some exceptionally fast torpedo-boats in course of construction for the French Government, which were to exceed what British builders had accomplished. With such a keen sailor and able administrator as Sir John Fisher, it was not necessary for Yarrow to dwell at any length on these facts. Touching very briefly on what he had seen, Yarrow said he would undertake to construct boats which should be in advance of those being built in France.

Admiral Fisher asked him to make an official report of what he knew of the French vessels, and to send proposals to the Admiralty for a boat which should surpass those in course of construction in France. The dimensions suggested by Yarrow were 180 feet long by 18 feet beam, of 4,000 horse-power.

Thus a new class of vessel, built to Yarrow's designs, and called the *Destroyer*, was originated, the object in view being that these fast vessels should chase and destroy torpedo-boats, as they had a higher speed, specially noticeable in rough weather, and were more heavily armed. The destroyer now forms an important section of every navy.

Two of these destroyers were ordered by the Government. They were named the *Havock* and *Hornet*. The *Havock* attained a speed on her official trial of 26·1 knots, and the *Hornet* 27·3 knots. The greater speed of the *Hornet* was due to the fact that she was provided with Yarrow water-tube boilers, which, although less in weight, generate more steam than the locomotive boilers of the old type, with which the

Havock was provided. Therefore the *Hornet*, besides being the prototype of the destroyer, is also of particular interest because she introduced the Yarrow boiler into the British Navy.

Evidence of the importance attached to these new developments in torpedo-boat construction is furnished by the fact that soon after the *Havock* and *Hornet* were completed the First Lord of the Admiralty invited several influential members of both Houses of Parliament to witness the manœuvres of these two boats in the Solent. The object of the First Lord was to impress his guests with the value of the new type of ship, and thus to obtain their cordial co-operation when the nation was called upon to vote a substantial sum for the increase of the fleet.

The Admiralty were so satisfied with these pioneer vessels that they came to the conclusion that vessels of this class were of the first importance, and placed orders for a large number, distributing the contracts among numerous firms in Great Britain.

It is not possible to write a true account of Yarrow's life without referring briefly to an incident which temporarily interrupted a long period of harmonious relations between the Admiralty and his firm.

Soon after the trials of the *Havock* and *Hornet*, it came to the knowledge of the firm that copies of the complete working drawings of their machinery were in the possession of numerous shipbuilders, to whom orders had been given for similar vessels, and who were naturally anxious to obtain for their guidance the most detailed information obtainable of the boats which had proved so satisfactory. Messrs. Yarrow were at a loss to know how it happened that their

drawings were thus distributed, and inserted the annexed advertisement in the Press. This led to the

£200 REWARD.—It having come to the knowledge of Messrs. Yarrow & Co. that COPIES of DETAIL DRAWINGS of the MACHINERY in H.M. Torpedo-Boat Destroyer "Havock" are being offered for sale, the above reward will be paid to anyone giving such INFORMATION as will lead to the discovery of the person so offering them for sale.

Poplar, London.

information that the designs had been placed by the Admiralty at the disposal of various firms, which was looked upon, not only by Messrs. Yarrow, but by the profession generally, as an incorrect proceeding. The Admiralty did not deny that they had adopted this course, but Messrs. Yarrow never obtained the recognition which they considered due to them, until the matter was taken up by some influential members in the House of Commons, and the value of their pioneer work acknowledged in Parliament.

Yarrow refused any kind of compensation in the form of money, as he contended he was fighting for a principle, in the recognition of his firm's work, and not for pecuniary gain. He felt that in distributing his complete designs broadcast over the country, without first obtaining his consent, the Admiralty were giving away the result of much original work and experience which did not belong to them but to his firm.

The satisfactory end of the dispute can be gathered from the following extract from *The Times*, August 15, 1894:—

THE NEW TORPEDO-BOAT DESTROYERS BY
YARROW & Co.

“ Sir U. Kay-Shuttleworth (Secretary of the Navy) made the following official statement :—

“ ‘ The Admiralty are glad to recognize that Messrs. Yarrow have been the contractors who had first constructed and completed with rapidity for the British Navy vessels of the high speed of the *Havock* and *Hornet*. On behalf of the Admiralty I am to express our satisfaction with the manner in which the contract has been carried out. We are also ready to acknowledge the value which we attach to the designs of Messrs. Yarrow for the machinery of these vessels. Practical proof has been given of this favourable opinion by our use of certain parts of these designs as a guide to contractors for some of the other torpedo-boat destroyers since ordered.’ ”

CHAPTER X

NOTABLE HIGH-SPEED BOATS, 1894-1912

The fourth stage in the development of the torpedo-boat as built in the Yarrow yard is well illustrated by the *Sokol*, and some interesting facts may be added about this vessel.

Yarrow felt sure that the results obtained by the *Havock* and *Hornet* could be improved upon, and persuaded the Minister of Marine in Petrograd to order a 30-knot destroyer which was named the *Sokol*.

A notable feature of this destroyer was that she was built of a class of steel new for the purpose. Up to this time what was termed "mild steel" had been used for hulls. As great stiffness rather than ductility was required for structures of this kind, the material called "Yolla" metal (now known as high-tensile steel) was selected, having a strength of 35 tons per square inch, as against 28 tons with mild steel. The stronger material permitted an appreciable reduction in the thickness of the hull, and the reduced weight was the means of securing a higher speed. As a matter of fact, the *Sokol* was the first vessel that ever attained a speed of 30 knots per hour.

This success resulted in high-tensile steel being exclusively used in the construction of similar vessels throughout the world.

The Russian authorities were so pleased with the

Sokol that they immediately laid down a number of destroyers intended to be exact copies of this boat, but want of experience in the Russian shipyards and the inferior quality of work produced bad results, these Russian-built destroyers being referred to in Semenoff's book on the war in the East as "unfortunate imitations of the *Sokol*."

In connection with this destroyer, an instance occurred of the so-called independence prevalent among engineers, which sometimes leads to a certain rudeness of manner. A reliable guarantee engineer was sent out to Petrograd with the destroyer. When H.I.M. the Tsar came on board, this engineer was the only man who did not take off his hat. The Tsar at once noticed this, and asked who he was, possibly with a view to sending him off to Siberia had he been a Russian subject. But it was hastily explained that he was a British engineer, and that they had curious habits in that country !

The Japanese had for some years viewed with suspicion the aggressive attitude of the Russians in the East, and in 1899 a large order for torpedo-boats and destroyers was entrusted to the Yarrow firm by the Japanese Government. A Yarrow armour-plated torpedo-boat, built in 1880, had won great praise during the war between Japan and China in 1894, having led the first torpedo attack on the Chinese shipping in Port Arthur.

The Japanese boats ordered in 1899 consisted of eight destroyers and ten torpedo-boats. The destroyers differed from those already constructed, and may be referred to as the fifth type of notable



THE *SOLOK*.

THE SHIP VISSES TO MAINTAIN A SPEED OF 30 KNOTS AN HOUR.

boats; they showed a distinct stage of progress, being of greater size and power. These boats were 220 feet in length, of 6,000 horse-power, and had a speed of from 31 to 32 knots.

The *Sazanami* attained great notoriety in the Russo-Japanese War, 1904-5, for she captured the Russian destroyer *Biedovy*, with Admiral Rojesvensky, Commander-in-Chief of the Russian Fleet, on board.

The opinion of the Japanese Admiralty as to the value of the vessels can best be illustrated by the following telegram from His Excellency Baron Yamamoto, Minister of Marine, Tokio, sent to Yarrow after their victory in the sea of Japan:—

“Destroyers you have built for us did excellent service throughout present war. Glad they are in good condition.—
YAMAMOTO.”

In 1904 a startling and practical demonstration of the value of torpedo-boats, far beyond anything which could be imagined, and certainly beyond anything which could be artificially prepared, was brought before the world, and those interested in naval warfare had sufficient matter for study and reflection during the struggle in the East.

The following reports, typical of many others, will serve to show the important part played by torpedo-boats in the Russo-Japanese war.

Extract from a Japanese Journal:—

THE FIRST ATTACK ON PORT ARTHUR ON FEBRUARY
8, 1904.

“The detachment of the flotilla sent to Port Arthur found the enemy lying outside the harbour. . . . It was a dark night, and the destroyers, instead of opening fire on the enemy from a distance, cruised slowly round under cover of darkness, until

they were near to the Russians, the torpedo-boats meanwhile following slowly and cautiously in their wake. . . .

“Under the shower of shot and shells, some torpedo-boats made a swift movement towards the entrance of the harbour, and there waited for a favourable chance of attacking the enemy with torpedoes. The Russians were apprehensive that the enemy might take advantage of the darkness to torpedo their battleships. The *Czarevitch* and *Retvisan* veered round and made for the entrance of the harbour. In a moment the Japanese discharged their torpedoes with deadly effect, and the two battleships sank in shallow water near the entrance of the harbour. The armoured cruiser *Pallada* was also attacked and disabled. . . .”

BATTLE OF SEA OF JAPAN, MAY 27, 1905.

In the course of a description of the battle of the Sea of Japan, which was the final and decisive sea-fight of this war, Admiral Togo reported:—

“ . . . An event occurred during this time which is worth specially recording for the heroism shown. This was the torpedo attack on the *Suvaroff*. A destroyer flotilla under Hirose, another flotilla under Suzuki, made a series of gallant torpedo attacks on the *Suvaroff*, which was disabled. The effect of the first attack was uncertain, but one of the torpedoes fired in the second attack struck the port quarter of the *Suvaroff*, and in a few minutes the great Russian ship showed a list of about ten degrees. In these attacks the *Shiarnui* and the *Asashio* were exposed to a heavy fire from the ships near the *Suvaroff*. Both received damage and were for a time in a dangerous position, but they managed to escape. . . . By this time the sun was setting, and our destroyer and torpedo-boat flotillas began to press on three sides. . . .

“Towards the evening the wind abated somewhat, but the seas were still running high, placing us in a disadvantageous position for torpedo attacks on the open sea. The torpedo-boats, fearing to lose an excellent opportunity which they might



THE SAZANAMI. ONE OF EIGHT DESTROYERS BUILT FOR THE IMPERIAL JAPANESE GOVERNMENT

LENGTH 220 FEET. BEAM 20 $\frac{1}{2}$ FEET. SPEED 31 $\frac{1}{2}$ KNOTS



THE LURCHER

LENGTH 261 FEET, BEAM $25\frac{1}{2}$ FEET, SPEED 35.345 KNOTS

not have again, came out from their shelter. They proceeded to attack the enemy, each flotilla vying with the other for the honour of taking the lead. . . .

“ At 8.15 o’clock, Yajama’s destroyers made the first stroke against the van of the main force, and then all the other flotillas simultaneously attacked on all sides, and continued their daring work until about 11 o’clock. The enemy defended himself desperately, keeping up a severe fire, and continually exposing our boats with his searchlights. At last the Russians gave way. Each ship became isolated, and each endeavoured to escape. Indiscriminate and indescribable fighting at close quarters ensued, and in this mêlée at least three large ships—the battleship *Sissoiveliky*, the armoured cruisers *Admiral Naklimoff* and *Admiral Monomakh*—were torpedoed and completely incapacitated for further fighting or navigation. On our side three torpedo-boats were sunk by the Russian fire ; and four destroyers and three torpedo-boats were more or less damaged, and had to fall out for a time. . . . We afterwards learned from the Russians taken prisoners, that the determined torpedo attacks on the night of the 27th were almost beyond description. They were repeated in such quick succession that the Russians had no time to repel them, and the small boats got so close under the Russian ships that the latter’s guns could not be brought to bear. . . . About 2 o’clock a.m. on the 28th Suzuki’s destroyers sighted two Russian ships steaming northwards about 27 miles north-east by east of Karaski.

“ The flotilla immediately attacked the Russians and sank one of the vessels, which, according to the statements of prisoners later, proved to be the battleship *Navarin*. This ship was struck on either side by two torpedoes in rapid succession, and went down in a few minutes.”

In summing up the lessons learned from the war in the East, with regard to torpedo-boats and destroyers, and their exceptional work, attention should be drawn to several points :—

(1) The destroyer is a small and inexpensive vessel, which carries what may perhaps be termed the most

destructive weapon known in modern naval warfare, and therefore an admiral, who might on many occasions hesitate to take chances with a large and costly ship, could afford to send, whenever an opportunity for harassing the enemy arose, a flotilla of such small craft without risking much in the event of their loss.

(2) The Japanese commanders placed great importance on the safeguarding of their warships under all circumstances by torpedo flotillas, and they rarely, if ever, allowed the battleships to be far away from the base without being accompanied by flotillas of torpedo-boats to safeguard them when navigating in dangerous waters.

(3) It must be noted that the uses of torpedo-boat and destroyer are not limited to discharging the "Whitehead." Owing to their speed and handiness they were frequently used during this war in the East as mine-layers, mine-sweepers, and dispatch-boats. They partially enforced a blockade by guarding against the smuggling of contraband of war.

(4) The torpedo-boat and destroyer are eminently adapted to attack under cover of darkness. Owing to their small size and swift speed they can frequently escape the searchlights and the enemy's fire, run into close quarters, inflict damage, and escape out of the danger zone. There is no doubt that these little boats are able seriously to harass an enemy's fleet, for, on account of their extreme activity, it is not possible for the crew of a battleship which is open to attack, to seize an opportunity by night or day for rest or relaxed watchfulness. The effect of this condition of continuous strain and alertness must not be overlooked in apportioning the value of the torpedo-boat

and destroyer flotillas in demoralizing the " personnel " of the enemy's ships.

Yarrow & Co. were also brought into prominence during the Russo-Japanese war by the affair of the *Caroline*. Great Britain, being a neutral state, the history of the *Caroline's* daring run from the Thames to the Baltic was fully discussed in every newspaper from *The Times* to the *Star*. The matter attained an altogether exaggerated and artificial notoriety, but the name of the boat, with the tempest of excitement to which her small adventure gave rise in the Press, is still remembered, and therefore an authentic account must not be omitted.

The *Caroline* was a fast turbine vessel of only 110 tons, built by the Yarrow firm for experimental purposes.

The following copy of their letter published in *The Times* of December 3, 1904, gives all the important facts of the incident :—

" SIR,—We feel that public opinion demands that we should say something with reference to the *Caroline* incident ; and we therefore, with your permission, propose to throw off the reserve we have hitherto maintained and make known the facts.

" It will be remembered that we built the high-speed yacht *Tarantula* (now owned by Mr. Vanderbilt) for the late Colonel McCalmont, and, having in view its great success, we laid down two similar vessels, but only completed them to a certain stage, so that they might be fitted up either as yachts or torpedo-boats—thus securing two strings to our bow in order to secure purchasers.

" During the last four months we have had numerous opportunities of selling these vessels as torpedo-boats at very high prices, but declined such offers, having our suspicions that they were wanted for one of the Powers at war.

" The policy of our firm in connection with these vessels can

be best described by the correspondence which took place between the authorities and ourselves on one occasion when we were negotiating the sale of the same vessels with a Paris firm.

"We informed the Admiralty, July 22, of the proposed sale. Admiralty telegram received July 23, stating they had referred the matter to the Foreign Office. Telegram from Foreign Office, July 23, asking for fuller information. We replied July 25, giving further information. Letter from Foreign Office, July 28, requesting us to postpone further negotiations. Letter from Foreign Office, August 10, asking us not to complete the sale, as it was believed the vessel would fall into the hands of one of the belligerents. We wrote, August 11, stating that we were acting as desired.

"Touching the final sale of the *Caroline*. On September 23, Mr. Sinnett, of Paris, accompanied by the Hon. James Roche, called at our works. One of these gentlemen stated that, having taken a cruise in the *Tarantula* along the American coast, he was much pleased with her, and desired to purchase a similar yacht for a wealthy American. Knowing the craze in the States for fast yachts, we saw nothing unusual in this. They agreed to pay the standard price we obtain for vessels of this type, and to give us an instalment on account.

"It may here be stated that the *Caroline* was of the same dimensions, built from the same lines, provided with machinery of the same class and of the same power as the *Tarantula*, and was, in fact, in all essential particulars identical. As previously stated, she was only completed up to a certain point—that is to say, the hull and machinery were finished, but as regards cabin accommodation and fittings nothing was done; and we were instructed to fit up the *Caroline* as a yacht.

"Having in view the number of vessels the Russian Government had lately purchased, and knowing that during the Spanish-American War many fast yachts were fitted up as gunboats and torpedo-boats, we were quite alive to the possibility of the *Caroline* ultimately getting into the hands of one of the belligerents; therefore, to be on the safe side, on September 24 (the day after the sale) we communicated with the Admiralty, giving all the particulars we had, including the name and address of the purchaser, and stating that the vessel

would be handed over to him when certain additions were made. We received an acknowledgment, without comment, on September 30.

"The additions required to the *Caroline* were completed on October 3, and, as we thought ample time had elapsed from the date of our letter, September 24, especially in view of the prompt action taken by the Government at the time of the previous offer referred to, we felt fully justified in receiving payment from Mr. Sinnett of the balance, and, in exchange, handed him builders' certificate, when our connection with the *Caroline* ceased. She left midday, October 6. We were told she was going to Hamburg, and that arrangements had been made for her to be towed out to New York by a German steamer, which we had no reason to doubt. There was no armament of any kind on board, and very considerable alterations would have to be made to fit her as a torpedo-boat.

"We have the honour to remain, sir,

"Your obedient servants,

"for YARROW & Co., LTD.,

"(Signed) A. F. YARROW.

"Isle of Dogs, Poplar, E.

"December 2nd, 1904."

Suspicion had been aroused that the Yarrow firm were aware that this little fast yacht was intended for use as a war vessel by the Russian Government, partly in consequence of the evidence of a British sailor who stated that he had seen, secreted in the engine-room, a torpedo tube. But on closely questioning him, it was found that, never having seen a turbine engine, he had mistaken its casing for a torpedo tube. At this period, it must be remembered, marine turbines were in their infancy. Yarrow was summoned to appear at Bow Street, as the principal witness on behalf of the Crown, who had decided to take action against the two purchasers, and a summons was issued for their arrest. These gentlemen, however, were the heroes

of the hour, in Paris, and, the offence being political and not criminal, an order for their extradition could not be obtained.

The incident caused Yarrow a great deal of annoyance, but the storm blew over in a few days.

When questioned by the Government authorities as to what he knew of the respectability of the purchasers, Yarrow stated that he considered the son of a British peer should be above suspicion ; but Lord —, who was at the head of the Criminal Department at the time, and a nobleman himself, said he did not deem this evidence of respectability sufficient. Yarrow also submitted that he had no "Private Intelligence" Department in connection with his works, and he felt that, having given full information of the purchase and the names of the purchasers to the Admiralty eleven days before the vessel left the Thames, he had done all that could reasonably be required of him.

It may be needless to state that this little vessel could never possibly have been sent out to the East, because her limited coal capacity would have necessitated many stoppages on the way, thereby rendering her liable to be detained at any neutral port. As a matter of fact, she took no part in the war.

The sixth definite advance in destroyer construction came about as follows :—

During the year 1910 the Germans were constructing some fast destroyers, averaging 30 knots per hour, while the British were building what were termed "27-knot" destroyers. Yarrow repeatedly pointed out to the First Lord of the time, what appeared to him the absurdity of having vessels which could neither catch the German destroyers nor run away

from them. But his remarks were of no avail. There was a very general conviction at the Admiralty that seaworthiness and strength would have to be sacrificed to gain greater speed. At last, when Admiral Jellicoe was Controller, Yarrow approached him with the suggestion that his firm should be allowed to build some destroyers from their own designs, guaranteeing not only 32 knots, but also that the vessels would be thoroughly seaworthy, and the hulls of ample strength for service in the North Sea.

The Controller decided that as this firm and that of Thornycroft were the two specialists in this class of construction, he would give an order for three vessels to whichever of these firms made the best proposal. This competition led to an order being placed with Yarrow, and the vessels were named the *Firedrake*, *Lurcher* and *Oak*.

The "27-knot" boats, which, under favourable conditions, occasionally reached a knot or two more, were considerably surpassed by these three vessels, for in the *Lurcher* a speed of 35·345 knots was obtained, and under the stress of actual service conditions they were found to be of ample strength.

As might be expected, the success of these Yarrow destroyers at once led the Government to modify their designs, and put an end to the building of 27-knot boats.

A practical illustration of the increase of speed obtained by Yarrow with the *Firedrake*, *Lurcher* and *Oak* is well illustrated by the following incident described by an officer on board the *Lurcher* :—

"On a fine evening in the spring of 1912 a flotilla of destroyers, representative of the best and most powerful types in His Majesty's Fleet, lay at anchor in Bantry Bay. On board each

unit there was more than the usual evening activity, for preparations were being made to leave soon after sunset, the destinations being the various home ports upon which the vessels were based. Keen under normal conditions, a feeling of super-keenness reigns on such occasions, and in this particular case there was the added incentive of an exciting contest on the morrow, for the latest addition to the flotilla was to be pitted in a speed duel against all comers.

“Few who have not actually experienced it can conceive the thrill of such a contest, of which the initial preparations of ‘tuning up’ form a no small part. Nothing must be overlooked, and one would gladly forgive the accusation of over-anxious care of detail from the uninitiated, on such occasions.

“The flotilla was to steam quietly in formation until at some time after daybreak that milestone of the homeward-bound—the Eddystone—should be within the prescribed distance for the final race home and the ‘rendezvous’ for ‘parting company.’ In this case 80 miles was selected as the length of the course. Though the race was to be general, the new-comer was to be ranged up against a particular favourite—a vessel which, up to that time, had held the ‘blue riband’ of the British Fleet and probably of the world. There was considerable speculation, in more than one sense of the term, upon the result. Such confidence had we in our vessel that when, just before the ‘zero’ hour, the opponent captain finally offered his last odds in a considerable sum, the semaphore facetiously spelt out the reply to the effect that it would be unfair to accept the gift!

“That race marked another epoch in the romance of speed and the triumph of the evolution of design and workmanship, for in that race of two hours the Yarrow boat had left her opponent five miles behind: nor was the winner beaten until, long afterwards, she not unwillingly gave pride of place to a vessel modelled on her own lines.”

CHAPTER XI

THE ORIGIN OF BALANCING

In 1890 Yarrow and his family, accompanied by a friend, Mr. Dunell, visited the United States, travelling on board the *Majestic*, one of the best Atlantic liners of that time. Yarrow had a berth in what appeared to be a good position on board, and Mr. Dunell's berth was a little way removed from it. The *Majestic* was propelled by twin-screws; and, as at this period turbines for ship propulsion were not thought of, the engines were of the usual reciprocating type. Although not far from one another, Yarrow's berth showed at times a great amount of vibration, from which the one occupied by his friend was free. This led to a discussion between them as to the cause of such difference. With the object of testing the extent of the vibration, and its frequency, the following experiment was made. Yarrow collected a number of india-rubber bands, and uniting them together so as to make one length, he secured one end to the roof of his cabin, and loaded the lower end with a weight. To this weight he fastened a pencil horizontally. Although the part of the steamer in which this experiment was tried vibrated up and down, the suspended weight with the pencil attached remained stationary, not taking up the movements of the ship, because the vibrations were not transmitted to them through the

elastic connection. It is evident that, if the point of the pencil were pressed lightly against a strip of paper attached to the side of the cabin but allowed a horizontal movement, as everything in the cabin would partake of the motion of the steamer (the weight and pencil attached to the elastic bands only excepted), the paper would move up and down with the vessel, and a mark would be produced by the stationary pencil, indicating the extent of the vertical movement of the paper and also the number of these movements per minute. This experiment showed that, when the moving parts of both the engines synchronized, the extent of the movement in the cabin amounted to five-eighths of an inch, and eighty such vibrations were made per minute. This continued so long as the vertical moving parts of the engines went up and down exactly together, but when the working parts of one engine went up at the same time as the corresponding parts of the other engine went down, the movement of one engine counteracted the effect of the other, the result being that no vibration was noticeable in the cabin. This fact proved that the objectionable vibration set up was due to the engines, and not, as was generally thought, to the propellers. On further investigating the subject, it was found that there were certain parts of the vessel which vibrated considerably, and other parts which did not vibrate. This was evident to anyone who walked along the deck. There were seven places in the length of the ship where the vibration was found to be exceptionally high, the maximum movement being at the bow and stern. Complaints were often made by the crews of torpedo-boats—vessels of light construction and powerful machinery—about the discomfort due to excessive

vibration. As this was more pronounced at the stern than elsewhere, it was generally supposed to be due to the action of the propeller. The hope of reducing this vibration, with its evil effect on the nervous system, was constantly in Yarrow's mind, and he became absorbed in these experiments during the voyage.

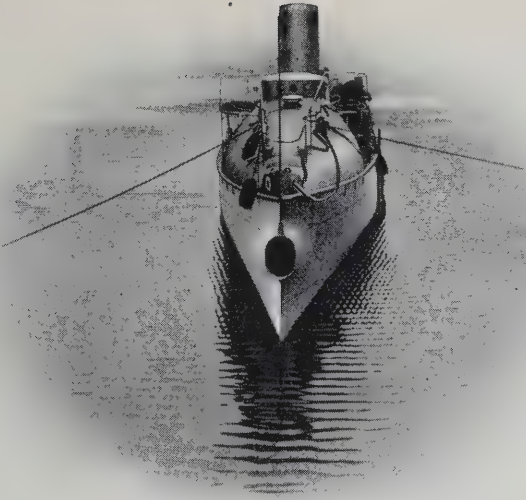
He determined on his return to investigate the problem thoroughly, feeling that fresh light had been discovered. A special apparatus, which was termed a Vibrometer, designed by one of the Yarrow staff, was used for the purpose of recording accurately the frequency and extent of the vibrations; and it was found that when the number of vertical movements of the working parts of the machinery coincided with the natural vibration which the hull could take up, the vibration became excessive; but, on the other hand, when the vertical movements of the engine were such as not to synchronize with the hull, little vibration was felt. Experiments were tried with a torpedo-boat under way, at varying speeds, and with corresponding numbers of revolutions of the engines; also similar revolutions of the engine when the vessel was stationary, the screw being removed, and it was found, contrary to expectation, that, whether the propeller was on or not, the extent and periods of vibration were exactly the same for a given number of revolutions. After this fact had been proved, further experiments were tried with the vessel moored in quiet water, which greatly simplified the tests, because they were not interfered with by motions set up in the vessel which occur when the vessel is under way, and waves are met with. It was found that the vibrations were entirely due to the unbalanced moving parts of the

engine, as had been proved on the *Majestic*, viz. that when the working parts of one set of engines were going up while those of the other set were going down, the one counteracted the effect of the other on the hull. It was therefore suggested that if equal weights could be set in motion in opposite directions to the working parts of the machinery the vibrations would be avoided.

Now, instead of each moving part having an equal weight moving in the opposite direction, it was found, by calculations of a very simple character, that all the moving parts could be equally well balanced by two vertical moving weights, one on each end of the engine, provided these weights were correctly proportioned, had the period of their vertical movements properly timed, and the extent of their travel accurately adjusted. On the experimental engine these weights were capable of being arranged as described, and connected or disconnected, within a very short time, and consequently experiments could be tried on the same day, under the same conditions, both with and without them.

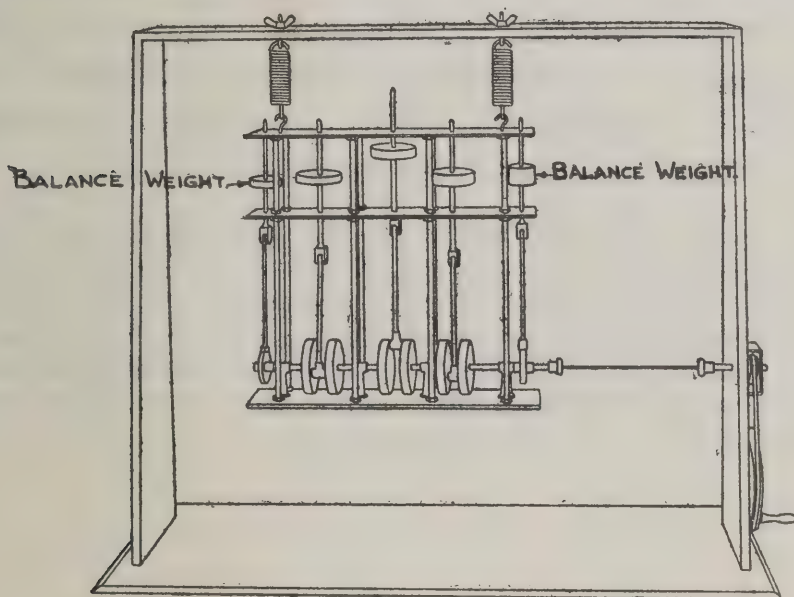
The illustrations show end and longitudinal views of the torpedo-boat during the progress of these experiments. When the photographs were taken the engines were making the number of revolutions which produced the maximum vibration; this is made apparent by the ripples produced on the surface of the water. When the additions to the engines were connected in order to counteract the vibration, no ripples were produced.

The subject was fully dealt with by Yarrow in a paper read before the Institution of Naval Architects in April, 1892. He contended that he had proved the



PHOTOGRAPHS SHOWING RIPPLES CAUSED BY VIBRATION
DUE TO UNBALANCED ENGINES

vibration was not due in any way to the propeller (provided it was properly balanced), but solely to the unbalanced moving parts of the machinery. He was asked how he reconciled with his theory the fact that the stern of screw steamers always vibrated so much more than any other part of the hull. He answered that a ship vibrated more at the stern for the same reason that the tip of a dog's tail, when it wags, moves more than the rest of the dog.



BALANCE WEIGHTS.

In order to illustrate his theory of balancing vertical moving bodies, when they form part of a structure on a foundation which is not solid, Yarrow used a model with balance weights which could be connected or not, as desired, of which an illustration is shown, and it was proved (on turning the axle round, which corresponded to the shaft of an engine) that when the balance weights were unattached the vibration of the structure, which was hung on springs, was violent,

whilst all vibration ceased when the two balance weights were connected.¹

To avoid misapprehension, it should be observed that the vibration we are dealing with in this chapter has no reference to that due to the shocks produced by the waves of the sea.

Yarrow's experiments were successful, and in combination with Dr. Schlick of Hamburg, who further investigated the subject on the same lines, four-cylinder engines were designed, having their weights so proportioned as to eliminate vibration. This arrangement, called the "Yarrow, Schlick and Tweedy" system, became universal in marine engineering throughout the world.

¹ In connection with these experiments Yarrow has stated their success was in a great measure due to the enthusiastic help given him by his friend Mr. W. Marriner. In fact, in after years Yarrow has often remarked that the success of the firm was greatly due to the scientific attainments and practical knowledge of Mr. Marriner, who, throughout a period of thirty years, always took the lead in their experimental work.

CHAPTER XII

THE YARROW BOILER

It should be stated, for the information of those who think that the invention of a water-tube boiler belongs to the nineteenth century, that such boilers were in existence as far back as the days of the Romans, one made of copper being found in the ruins of Pompeii.

The water-tube boiler was adopted, with a fair amount of success, during the early part of the last century in connection with steam on common roads, and no doubt would have proved perfectly efficient had the materials and workmanship been then of the same quality as are now available.

The history and development of the Yarrow boiler, which is fitted in the majority of war-vessels, and concerning which it will not be considered an idle boast to assert that they are of world-wide renown, must now be given.

Previous to 1878 the Yarrow firm had, by careful study, made great advances in the designs of both the hull and machinery of vessels, and with the knowledge available at the time, it appeared as though no further increase of speed could be attained in a given size of ship, unless a substantial reduction could be made in the weight of the boiler which generated the steam, and which was a very heavy item in the total displacement of the complete vessel. At this time the boiler which gave the best results for a given weight

in combination with forced draught, was of the locomotive type. But this class of boiler never seemed to be thoroughly reliable, on account of the risk of the tubes leaking; and it cannot be said that it was unattended with danger, for when a torpedo-boat returned after a full-speed trial the first question invariably asked was: "How's the boiler?"

It may naturally be inquired: "Why should a locomotive boiler on board a ship be so unreliable, when it is in use successfully all over the world on locomotives?" The difference in the conditions under which they are worked, however, is very marked, and the results are essentially influenced thereby. In the first place, the locomotive is in a constant state of vibration when moving at a high speed, which greatly aids the bubbles of steam to free themselves from the heating surfaces; whereas on board ship no such vibration takes place. Again, ordinary fresh water is used in a locomotive, while on vessels the only water available (because sea-water is out of the question on account of the salt it contains) is the water which has been previously generated into steam, has passed through the engines, been condensed, and has taken up a certain amount of grease, which is essential for lubricating purposes. This grease settles on the internal surfaces of the boiler. It is a non-conductor of heat, and a coating of it of the thickness of a piece of tissue paper may, under some conditions, be fatal; for if the heat cannot be transmitted to the water with sufficient rapidity, the result is overheating and ultimate distortion of the boiler plate.

The intensity of the combustion may be easily realized by watching a locomotive at night hauling an express train, and observing the lumps of live coal

flying up from the funnel. These pieces of coal have been blown from the fire and through the tubes so rapidly that the coal has not had time to be consumed. The same thing occurred on the trials of torpedo-boats, and those who formerly had to conduct such trials were liable to much discomfort, owing to the passing of red-hot coal down their backs, leaving a clear indication of the direction the incandescent cinders had taken.

One day in 1877, William Crush, who was the head of the boiler department, looked in at the cottage where Yarrow had lunch, and the conversation which then took place, although brief, led to somewhat important results for the firm.

Y. : "Well now, Crush, we must wake up about water-tube boilers."

C. : "Yes, we must."

Y. (putting his hands together with the fingers sloping on each side) : "Why not a boiler like this ?"

C. : "All right."

Y. : "Straight tubes ?"

C. : "Yes, we will go ahead and make one."

Experiments, which cost the firm many thousands of pounds, originated in this conversation. Engineers in all countries were at that time exercising their brains to produce a boiler which fulfilled the conditions of naval requirements to the fullest extent. Owing to the saving in weight effected in addition to the extra security afforded by the water-tube boiler, Yarrow directed the energies of his firm towards producing the best design of this type.

Experiments were actively continued with boilers

varying widely in design, the object being to simplify the construction as far as possible, and to produce a boiler which would be efficient, and at the same time would be so simple that any stoker could manage it. The importance of providing for free circulation, and of being able to clean the tubes internally and externally, were essential conditions to be kept in view.

Yarrow often remarked, when inventors of water-tube boilers came to him (for these gentlemen arrived in a continuous stream about this time), that it was a very difficult problem to make a boiler which would not work, but it was no easy matter to combine in the best possible manner all the requirements necessary to ensure complete success.

Many years and much money were spent in making tests before the Yarrow boiler assumed its final form and proportions, and it was not put into a torpedo-boat until 1887.

To show how thoroughly the experimental work was carried out, it is worthy of note that the Yarrow boiler as made to-day is substantially the same as when first brought before the public, extensive experience having shown that all the conditions which are essential to satisfactory working were successfully embodied in the original design.

We propose to give a general description of the boiler and a brief account of its development, but without going into technical details. It will be well, however, to describe first the main features of various boilers belonging to this class, and also to refer briefly to the work of others engaged in this field of investigation.

The distinctive feature of the water-tube boiler is that the water from which steam has to be generated

is inside the tubes, and the flame and hot gases come in contact with the outside of the tubes. In cylindrical and locomotive boilers this is reversed, the hot gases pass through the tubes, the water being outside.

The circulation in every type of boiler, instead of being intermittent, which is often the cause of trouble, should be regular, and the more rapid the circulation, the larger is the margin of safety, because it is evident that, the greater the speed of the water, the more rapidly are the bubbles of steam, as they form, swept away from the hot surfaces, and thus over-heating is avoided. Serious accidents have happened to cylindrical and locomotive boilers when forced beyond certain limits, owing to the sluggish circulation failing to carry off the steam immediately it is formed, and thus not allowing a sufficient supply of water to come into actual contact with the hot surfaces, so as to enable the heat to be conducted away and taken up by the water with sufficient rapidity.

After the beginning of the nineteenth century, as has already been stated, inventors worked at the problem, some in connection with steam carriages on common roads, and some in connection with ship propulsion. The first really successful marine water-tube boiler was introduced by Captain du Temple, a French engineer, who spent his fortune and a considerable part of his life in trying to make an aeroplane. This was before the days of petrol engines and motor-cars, so the aeroplane was to be driven by steam, and the Captain selected the water-tube type of boiler in 1873. The aeroplane was a failure, probably owing to the weight of the machinery being too great in proportion to the power it developed. The du Temple boiler for marine purposes was a partial success,

and may be looked upon as the first moderately efficient boiler of what is known as the Express Type, which later on included those constructed by Normand, Thornycroft and Yarrow.

The du Temple boiler was first adopted in steam launches in 1878, and was shortly afterwards fitted in some French torpedo-boats. From this time forward the water-tube boiler was gradually selected for the war vessels of the French Navy, and among those who contributed materially to the development of special forms should be mentioned two French engineers—Messieurs Normand and Belleville.

We will consider some points which have an important bearing on the success of water-tube boilers in general.

When Yarrow began his boiler experiments in 1877, there was very little encouragement from previous records, as there had been many fatal accidents, which made engineers suspicious of this type of steam generator. The main causes of failure were, firstly, the lack of knowledge of the laws which govern the circulation of water, and, secondly, the use of welded tubes, the only kind available at the time. In these boilers, as already explained, the tubes are subject to internal pressure, and those tubes exposed to the fiercest heat were found to be liable to burst, as a welded tube will fail more readily with internal than with external pressure, because in the latter case the pressure tends to compress the metal and keep its particles in close contact; while, on the other hand, if the pressure is internal, it tends to burst them, and very soon makes the smallest defect in the weld apparent.

Man's ambition to fly was directly responsible for

the invention of the du Temple boiler. Man's desire for rapid motion on wheels is responsible for many far-reaching developments, and it is interesting to note how one industry may affect another, although they may have no direct connection. Thus the success of the water-tube boiler is largely due to the advent of the bicycle. About the year 1886 the demand for improved methods of making bicycle tubing stimulated invention, and what are known as "solid-drawn" steel tubes were made on a commercial scale. They are drawn from a solid piece of steel, and have no weld.

A brief description of the Yarrow boiler, with reference to the illustrations, will enable the reader to appreciate those features which have contributed to its success.

Fig. A represents an end elevation, one-half with the casing removed, and the other half showing it in position.

Fig. B represents an end elevation with the casing removed.

Fig. C is a perspective view.

There are two nests of tubes which form the heating surface of the boiler. At the top end the tubes are secured into holes in the steam drum, and at the lower end into holes in what are called water-pockets.

All the tubes are below the water-level in the steam drum, so that they are under all conditions filled with water.

In cross-section the boiler is triangular, and the fire-grate forms the base of the triangle. Below the fire-grate is an ashpan.

The smoke casing consists of sheet steel and asbestos,

and the hot gases pass across the tubes, then on to the uptake and into the funnel.

The steam drum consists of a thick tube plate for the lower half, the upper half being thinner, because it is not perforated with holes for the tubes.

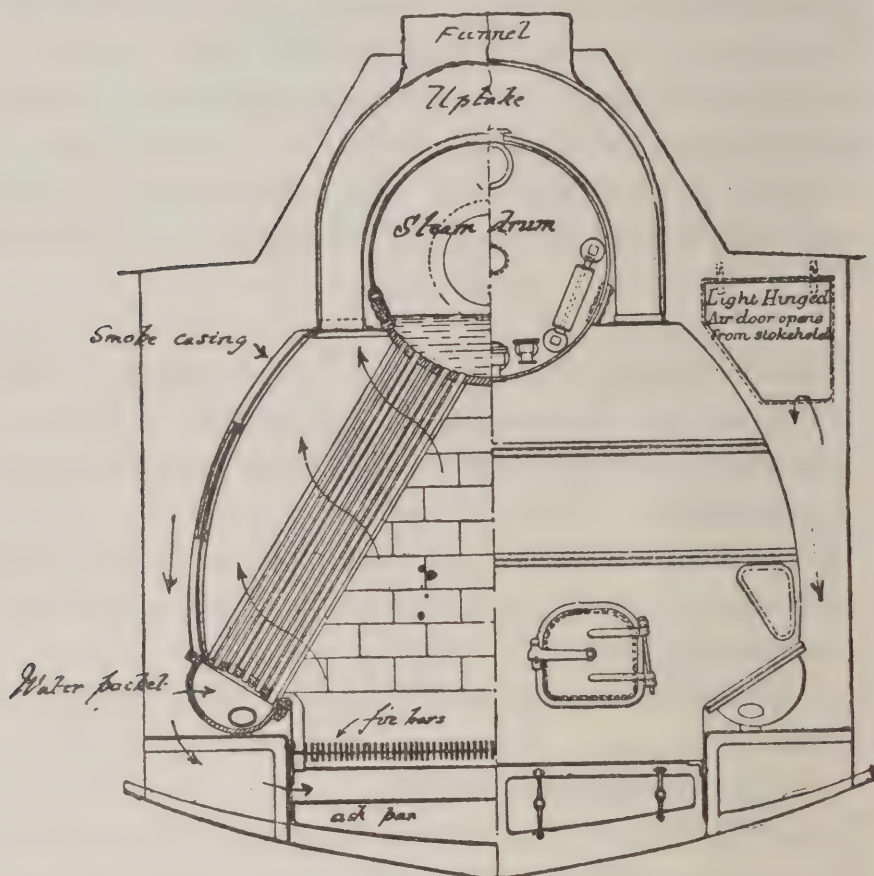


FIG. A.—YARROW BOILER—END ELEVATION (HALF CASING REMOVED).

The water-pockets, whenever possible, are made large enough to admit of a man getting inside.

The special feature of the Yarrow boiler which distinguishes it from all others of its class, is that the tubes are straight. In all other small tube boilers the tubes were bent into more or less fantastic shapes. Previous to the assured success of the Yarrow boiler, engineers thought it necessary to bend the tubes in

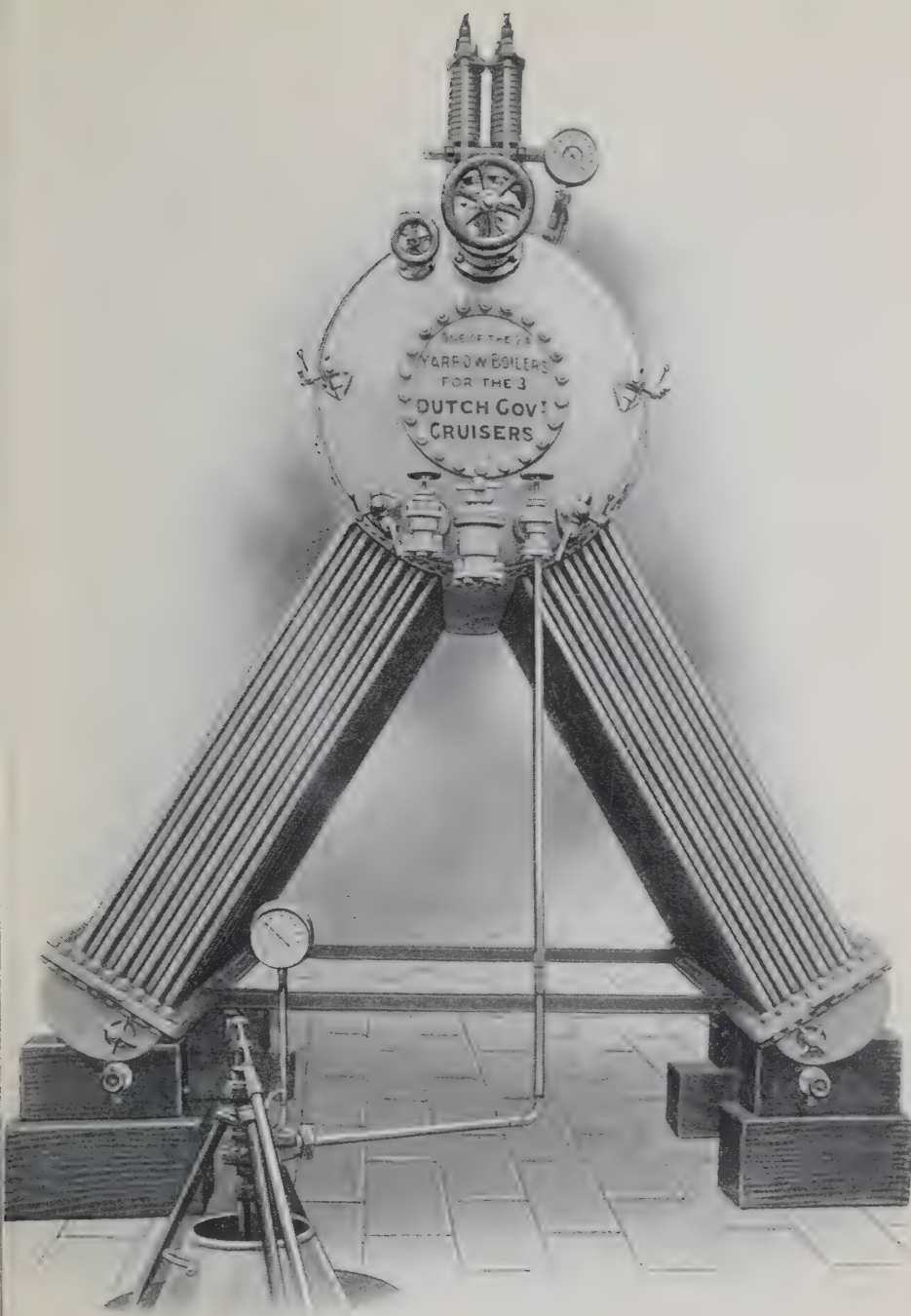


FIG. B
YARROW BOILER FOR DUTCH GOVERNMENT CRUISERS

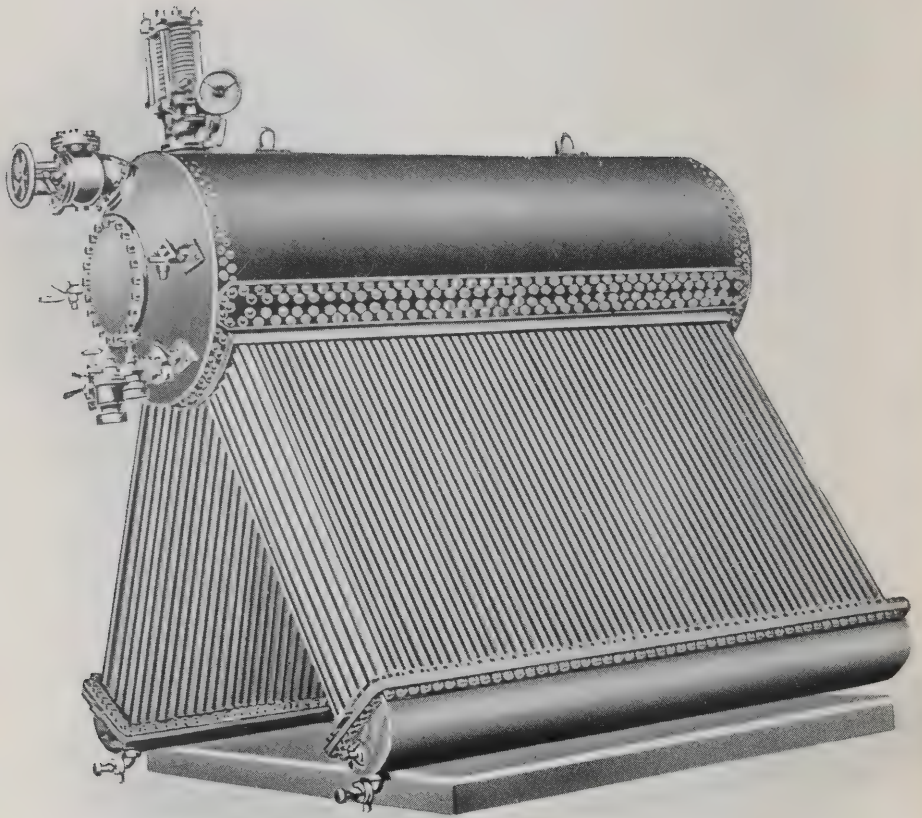


FIG. C.
YARROW BOILER

order to allow them to expand and contract freely when exposed to variations of temperature. Yarrow's experiments, however, conclusively proved that the tubes nearest the fire did not increase appreciably more in length than those farther from the fire, even when the rate of evaporation was much higher than ordinary practice demanded. The reason for this is that the temperature of the tube is practically the temperature of the water inside it, irrespective of the intensity of the heat outside. Consequently, as Yarrow often said, to bend the tubes to allow for variation of length was to guard against a difficulty which did not exist. Under certain conditions, however, the tubes nearest the fire may bend slightly, probably owing to the internal surface not being perfectly clean, which would mean that the metal of the tube might attain a temperature slightly higher than the water contained in it. Yarrow often contended that after use such slight bending of the tubes should not be looked upon as a defect, saying: "If the tube wishes to bend, let it do what it wishes, for if we oppose the forces of nature we shall certainly come to grief."

It is self-evident that the cleaning of the tubes internally is of the utmost importance, and one reason for the general adoption of the Yarrow boiler is that each tube, being straight, can be examined internally. A man in the steam drum can look through each tube, while another man holds a light at the lower end. Any obstruction in a tube is liable to cause it to over-heat and burst, and if the tubes are bent, it is impossible to examine or clean them efficiently.

In every class of boiler there must be proper provision for the circulation of the water, and in a boiler working at a high rate of evaporation this becomes more

essential. In the Yarrow boiler the circulation is allowed to adjust itself in accordance with the laws of gravitation, and the design is so satisfactory, and the circulation so active, that the rate of evaporation may amount to as much as 25 lb. of water per square foot of heating surface per hour, without risk of overheating the tubes.

The advantages of the Yarrow boiler may be briefly summarized as follows :—

It is simple to construct, and easy to maintain.

The tubes can be thoroughly cleaned internally, and the inside surface of each tube can be easily examined.

The very rapid circulation enables the boiler to stand excessive forcing without damage, so that, if two or three boilers in a big installation are thrown out of action by shot or otherwise, it is perfectly safe to work the remaining boilers to an extent considerably in excess of that for which they were designed.

The large furnace capacity enables the combustion to be carried out very completely, far more than in boilers of many other types, where the combustion has to take place in a space of restricted size. A small combustion chamber is specially objectionable in cases where the tubes approach the horizontal, because when the gases in the act of uniting with the oxygen of the air come in contact with the cold surface of the tubes, their combination is stopped in the same way that the gauze screen of the Davy lamp prevents the flame inside from passing to the explosive gases outside.

To throw light upon the question of circulation, Yarrow arranged a unique set of experiments,

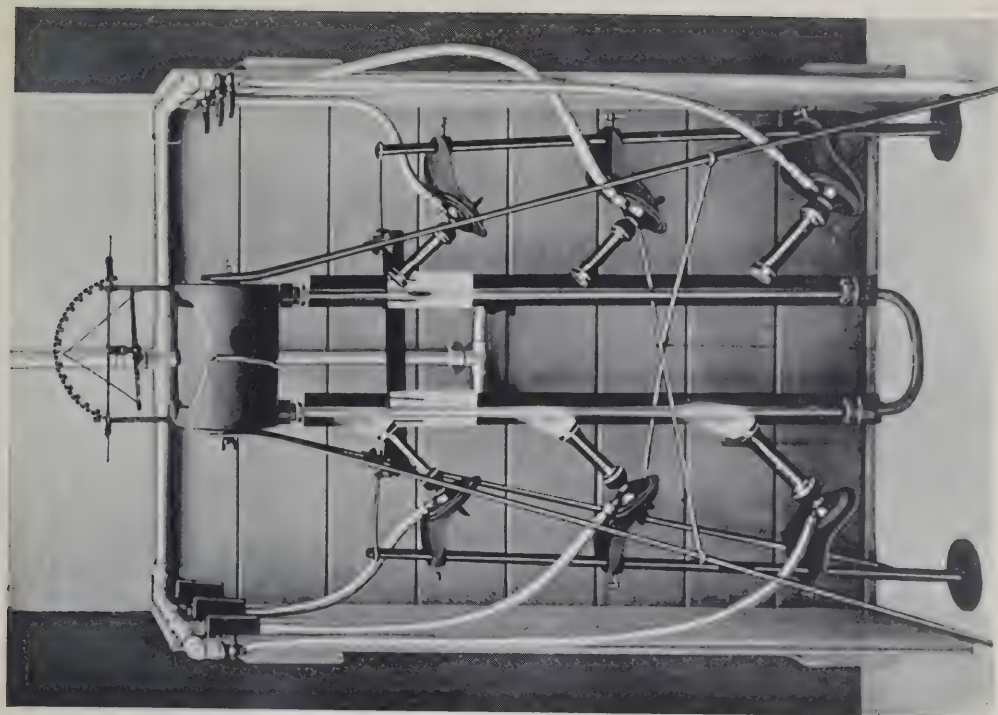


FIG. E.

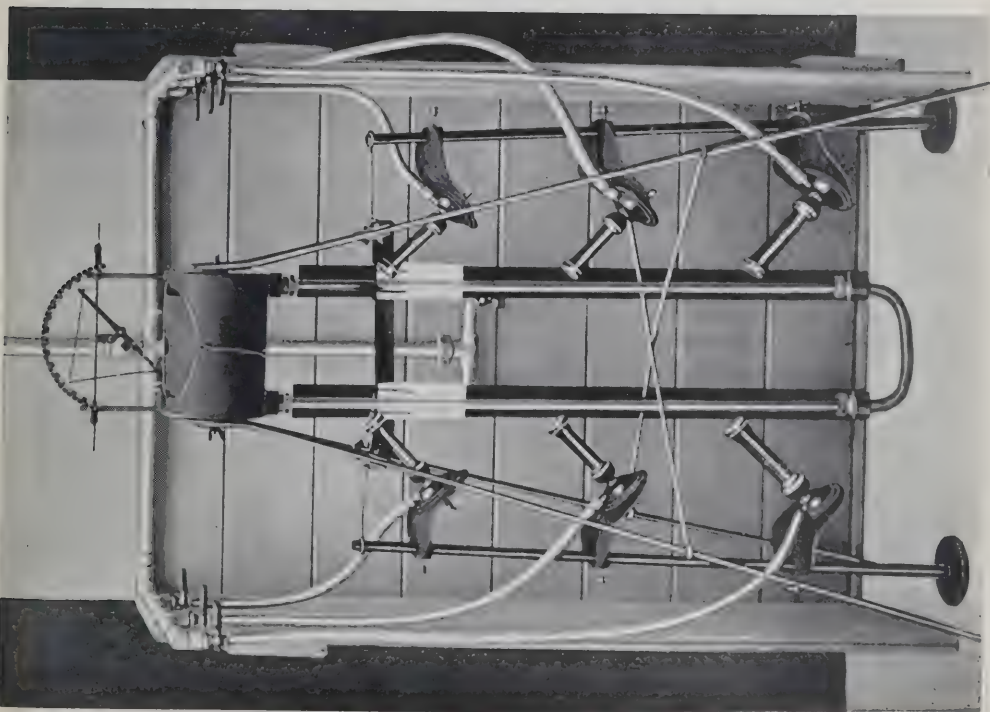


FIG. D

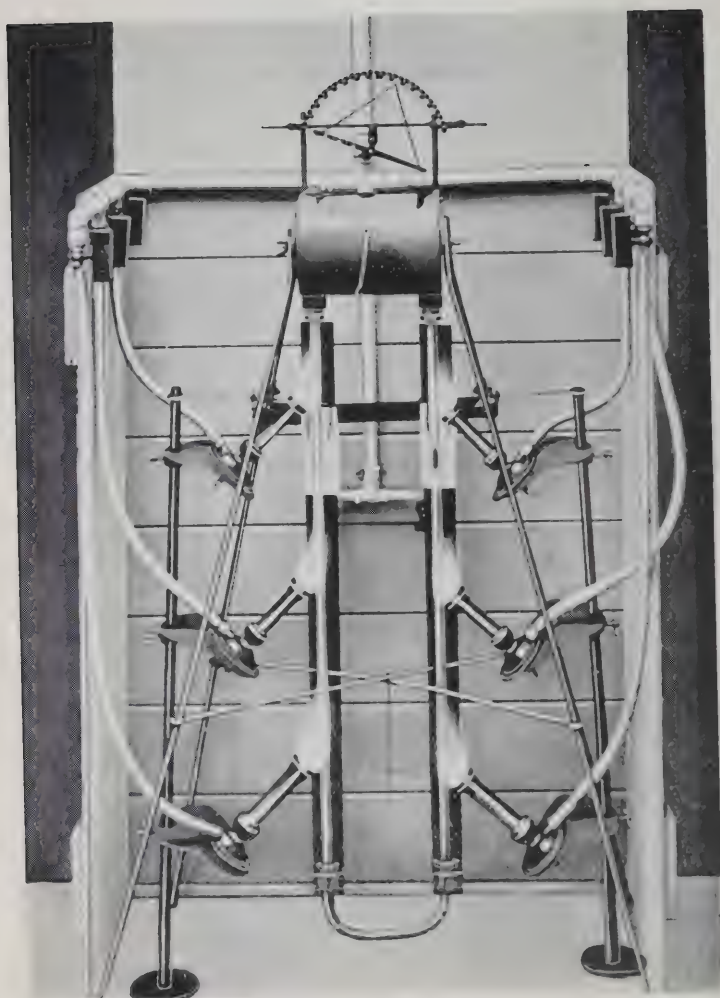


FIG. 1

illustrated by *Figs. D, E and F*. The model apparatus consisted of two vertical glass tubes with their upper ends attached to the bottom of a small tank, the tubes being united at their lower ends by a copper bend. The small tank was partially filled with water, and the two tubes in consequence were completely filled. Three gas burners were arranged to act on each tube. At the top of the model there was a balance. To the arm on the right was hung, by means of a thin cord, a grooved ebony bob, and the other arm was loaded so that it took up the position shown in *Fig. D* when the water was at rest. The bob was suspended in one of the tubes, so that, if a downward current were set up in the tube, it drew the bob downwards, and depressed the end of the balance to which it was attached. Before heat was applied, the balance was in the position shown in *Fig. D*. When one burner was lit on the left side, an upward current was started in that tube. When three burners were acting on the same tube, the current was accelerated, and the balance took up the position shown in *Fig. E*. When the burners which acted upon the tube containing the down-current were lighted, it was found, contrary to general expectation, that the circulation became still more rapid, and the position of the balance, when three lamps were acting on each tube, is shown by *Fig. F*.

Although this experiment did not show the speed of the current in the tubes, it proved that the circulation increased in rapidity as the heat was applied to the tube containing the down-current.

In nests of tubes it was found that there was always an upward current in those tubes which were nearest the burners, and a downward current in those farthest

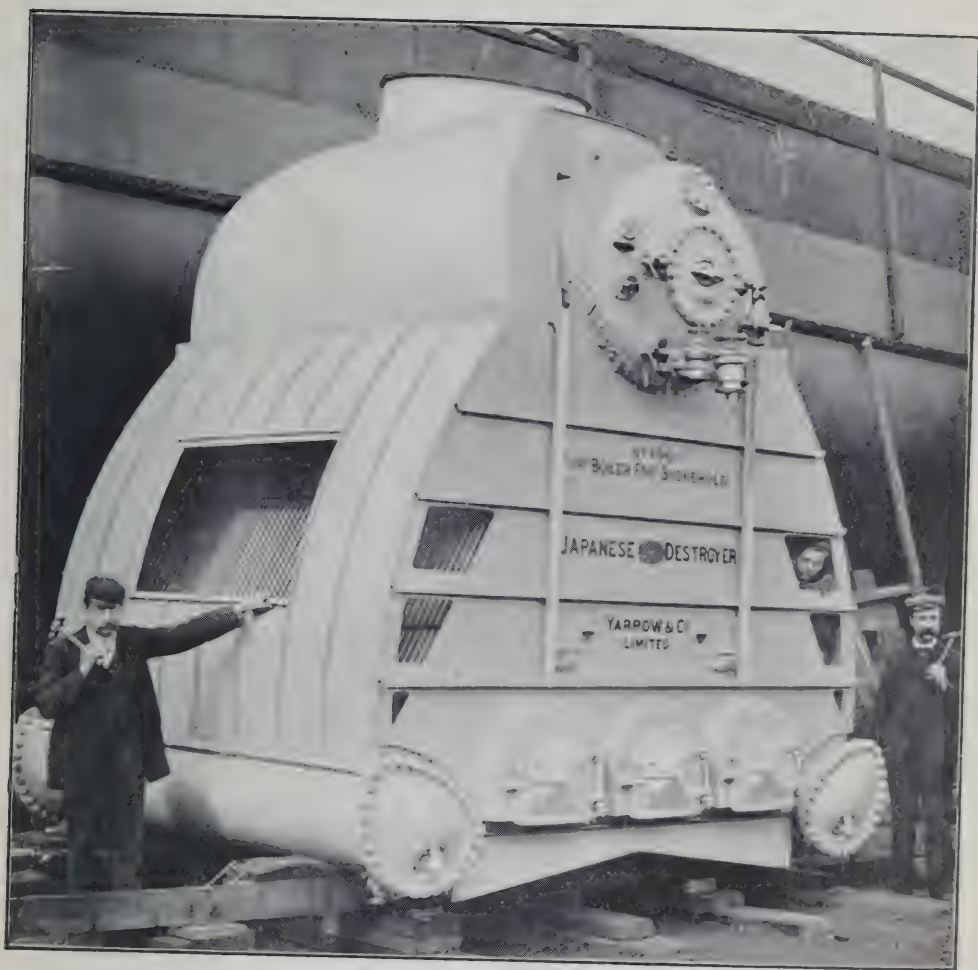
from the burners ; and when once the circulation was established, it was maintained in the same direction. These facts were proved throughout the experiments. In connection with this, Mr. McFarlane Gray, at a meeting of the Institution of Naval Architects, referred to one of Solomon's proverbs as illustrating very happily what occurs in a water-tube boiler, for Solomon says : " Train up a child in the way he should go, and when he is old he will not depart from it."

Monsieur Normand, and Yarrow, originally took widely divergent views on the laws which governed the circulation of water in water-tube boilers, but it should be mentioned that the discussion was carried on in a most friendly spirit.

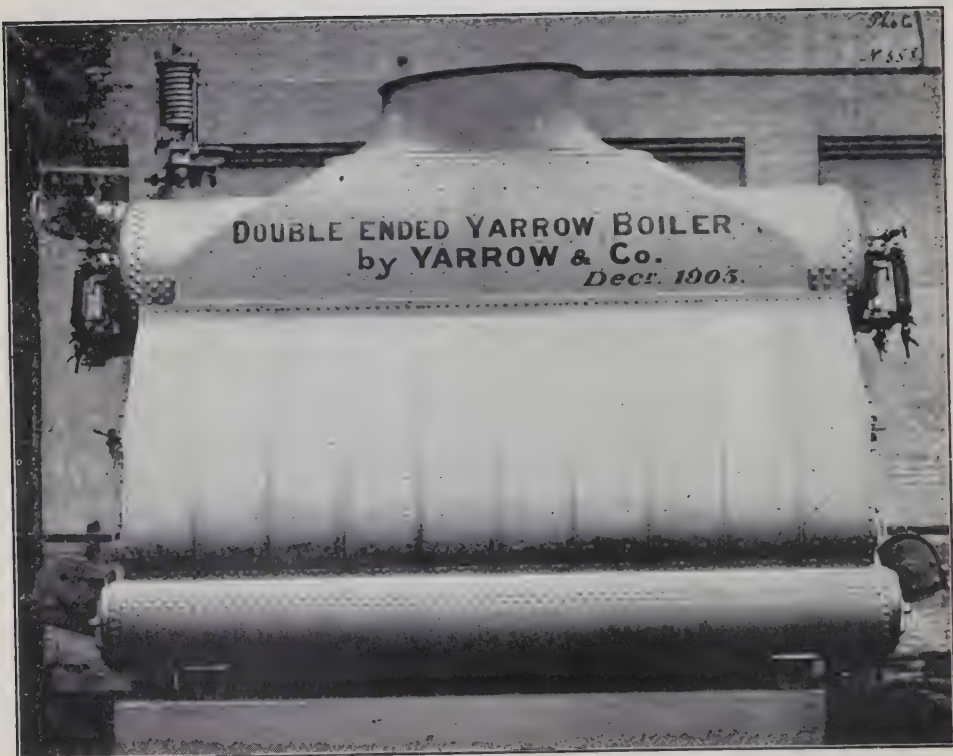
Although these gentlemen were keen competitors, of different nationality and religion, an unusual proof of the good feeling existing between them was shown by the fact that Monsieur Normand's son served part of his time in Yarrow's yard, and Yarrow's eldest son worked for a short period in Monsieur Normand's yard at Havre.

We will now give a brief account of the progress of the Yarrow boiler after its efficiency had been demonstrated by repeated tests under service conditions :—

The first Yarrow boilers tried in war-vessels were supplied for second-class torpedo-boats in 1887. Among other early vessels fitted with these boilers were some torpedo-boats built in 1890 for the Argentine Government, and, owing to the highly successful results obtained, this boiler was selected for the British destroyer *Hornet*. In 1893, when the *Havock* and *Hornet* were built, it was decided, in order to test the relative merits of locomotive and water-tube boilers,



A YARROW BOILER FOR A JAPANESE DESTROYER



FIRST DOUBLE-ENDED BOILER, CONSTRUCTED FOR THE
SPANISH GOVERNMENT

that both vessels should be alike in every respect, except that the *Havock* was to be fitted with locomotive and the *Hornet* with Yarrow boilers. On trial, the displacement of the *Havock* was 11 tons more than the *Hornet*, owing to the greater weight of the boilers. The *Havock* attained a speed of 26·1 knots, and the *Hornet* a speed of 27·3 knots. The coal consumption for the same speed was found to be about 5 per cent less in the *Hornet* than in the *Havock*. This comparative trial formed a conclusive proof of the advantages of the water-tube boiler.

The success of the Yarrow boiler led to its extensive adoption in foreign warships.

In 1895 the Russian destroyer *Sokol* was supplied with eight Yarrow boilers ; and it will be remembered this was the first vessel to attain a speed of 30 knots.

The Dutch are admitted to be specially progressive in their naval policy ; their technical authorities were the first to recognize the value of the Yarrow boiler for large warships, and in 1896 they adopted it in three cruisers of 9,250 h.p. Each vessel was provided with Yarrow boilers of 7,000 h.p., and cylindrical boilers of 2,250 h.p. (*see* Illustration facing p. 137).

In 1905 Yarrow decided to try a double-ended boiler—that is, a boiler fired from each end. The first of this type was constructed for the Spanish Navy, and is shown in the illustration. A very exhaustive set of experiments was made with this boiler, proving that in this design reduced weight and more space were secured, combined with a slight gain in economy as compared with single-ended boilers. This type was also adopted in ten destroyers constructed by the firm during 1908 to 1910 for the Brazilian Government. The h.p. in each vessel was 9,000, supplied by two

boilers. The illustration shows four of these boilers completed in the shop.

There can be no question of the success of the boilers in these ten destroyers, when we read the letter from His Excellency the Minister of Marine addressed to the firm after all the ten vessels had arrived at Rio. It must be remembered that the boilers were in charge of inexperienced men.

(Translation.)

MINISTRY OF MARINE,

RIO DE JANEIRO.

17th October, 1910.

MESSRS. YARROW & Co., LTD.

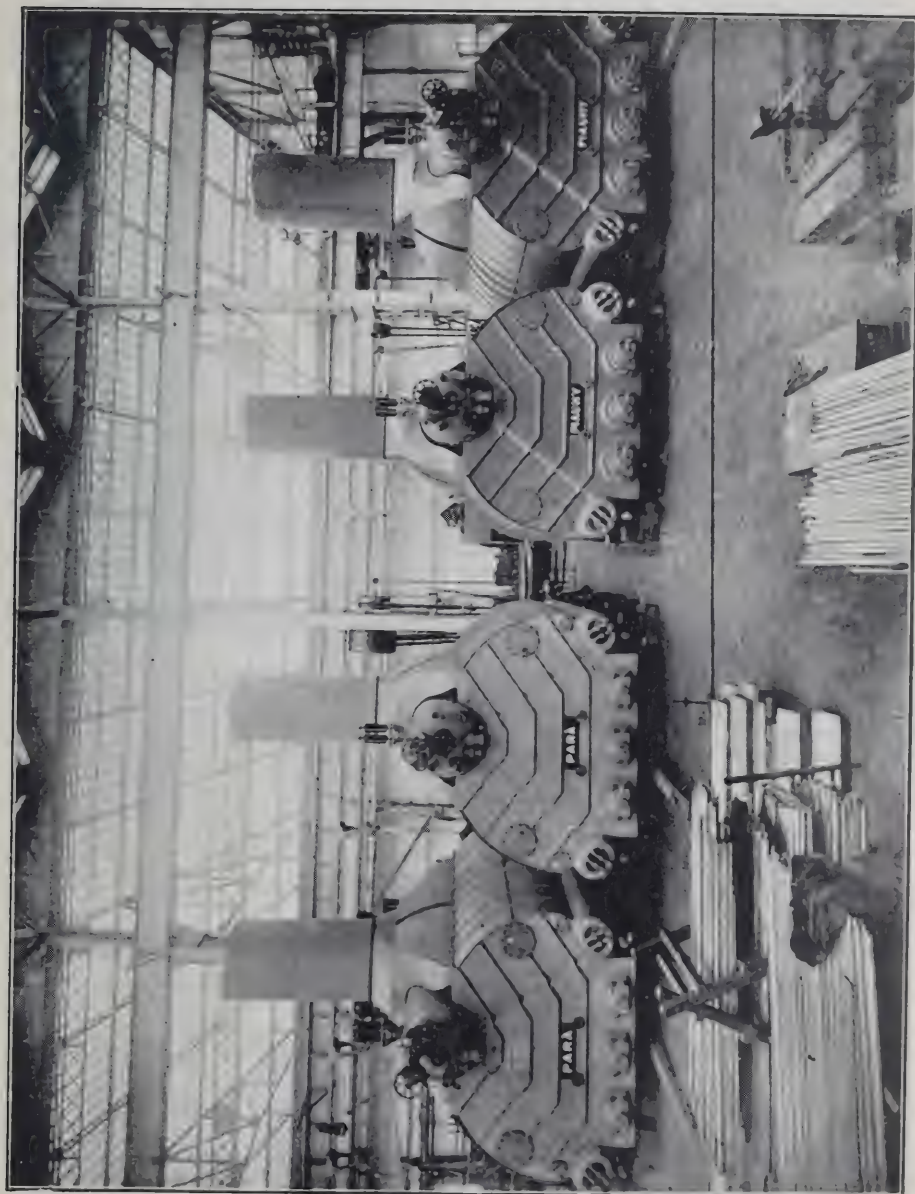
The Minister of Marine has the satisfaction of stating that the ten destroyers ordered from the firm of Yarrow & Co. arrived in Rio de Janeiro in good condition, both as regards machinery and hull, notwithstanding the long journey which they made and the storms encountered by some of them during the voyage.

Health and fraternity.

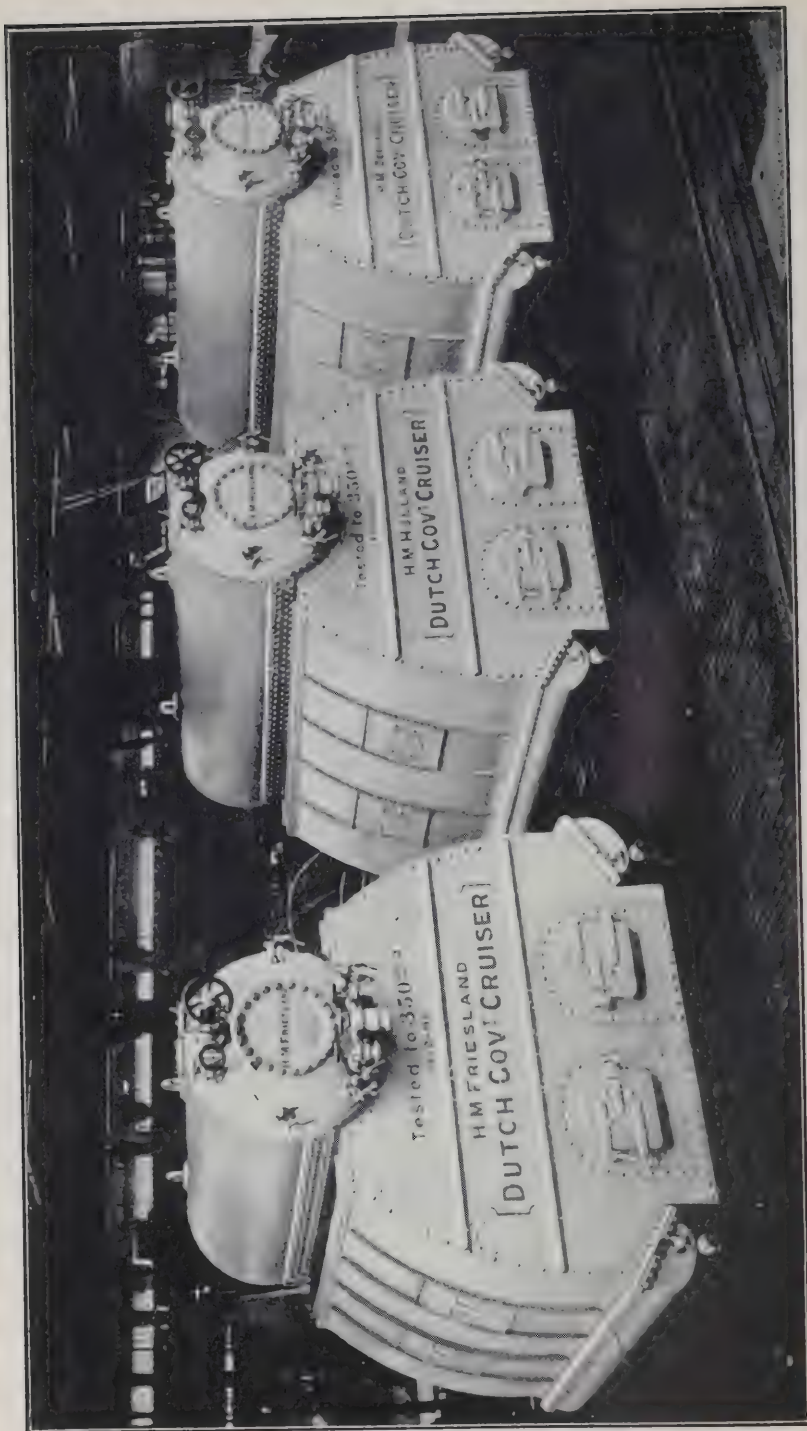
(Signed) ALEXANDRINO FARIA DE ALENCAR.

Yarrow visited Rio de Janeiro during the latter part of 1921, when he found the destroyers built at Scotstoun were in the most perfect condition, and capable of attaining speeds quite equal to those obtained on their trials, reflecting the greatest credit on the Brazilian naval authorities.

The advantages of superheating steam have been recognized by marine engineers for many years, but owing to the difficulty of controlling the amount of superheat, it has only been slowly adopted. The trouble was principally in connection with overheating of the superheater tubes. When the main



FOUR DOUBLE-ENDED BOILERS COMPLETED FOR THE BRAZILIAN GOVERNMENT



YARROW BOILERS FOR DUTCH CRUISERS

engines were suddenly eased or stopped, the flow of steam through the superheater would be greatly reduced, and as the supply of heat to the superheater could not be quickly regulated, the consequence was that under these conditions overheating of the steam took place. This overheated steam went through the engine when it was again started, and injured the valves and rings of a reciprocating engine or the blades of a turbine.

Many attempts were made to regulate the amount of superheat, and eventually Yarrow's suggestion for fitting the superheater on one side only of the boiler was found to be a satisfactory solution of this problem. The amount of heat which passes to the superheater in this arrangement can be easily regulated by a damper placed above the superheater, and controlling the passage of the gases on that side of the boiler only. If the damper is entirely closed, then all the hot gases pass up the other side of the boiler to the funnel, thus shutting off the heat altogether from the superheater tubes.

Experiments were tried on a large scale with this superheater and damper, which proved to be an unqualified success. It was found that not only was the amount of superheat well under control, but the arrangement had the further advantage of diminishing the generation of steam when the engines were suddenly eased or stopped, as the heating surface exposed to the hot gases was reduced to one-half when the damper was closed.

Yarrow boilers with this improved type of superheater were first installed in H.M. ships *Archer* and *Attack*, which vessels ran their trials in 1911. The resulting economy was most marked, at full speed

being about 10 per cent better than similar vessels, and at low speed about 15 per cent better, and since that date Yarrow's patent superheating boilers have been adopted very extensively.

On actual service it was found that there were other advantages connected with superheating in addition to that of increased economy, i.e. :—

1. The engine room is much more comfortable, being drier and freer from vapour, the leakage with superheated steam being less than with saturated steam.

2. The engines can be got under way much more quickly, owing to its being safer to warm them up with dry superheated steam than with wet or saturated steam.

3. The risk of water being carried over with the steam is greatly diminished.

In conclusion, it will be readily admitted that, after having passed through a long period of opposition, the Yarrow boiler has, by its own merits, won its way to success. And it should be added that Yarrow always attributed, to a great extent, the success of the boiler to the cordial co-operation of his old friend, Mr. William Crush.

CHAPTER XIII

IMPROVEMENTS WHICH LED TO HIGH SPEEDS

Although previously referred to in the account of the notable boats, each of which introduced some new feature, it may be of interest to sum up in concise form the developments in shipbuilding and engineering which have led to the present high speeds.

Few people outside the engineering profession have any knowledge of the difficulties encountered in trying to secure an increase of speed. To give some idea of how rapidly the resistance is augmented as the speed increases, it may be stated that, to drive a vessel at 20 knots as compared with the same vessel driven at 10 knots, eight times the power is required. Apart from the mechanical difficulties involved, as the cost of machinery is approximately proportionate to the power, it will easily be realized how serious is the effect upon the pocket of the tax-payer or the trans-Atlantic traveller of a demand for greatly increased speed.

It will have been seen from the description of the principal torpedo-boats built at the Yarrow works that, although fast steam launches, and even rowing boats, have been used with success, the maximum efficiency in torpedo warfare can only be attained in a boat designed from bow to stern for carrying armament and for providing the maximum comfort, or perhaps

it might be more correctly expressed, the minimum discomfort, for the crew.

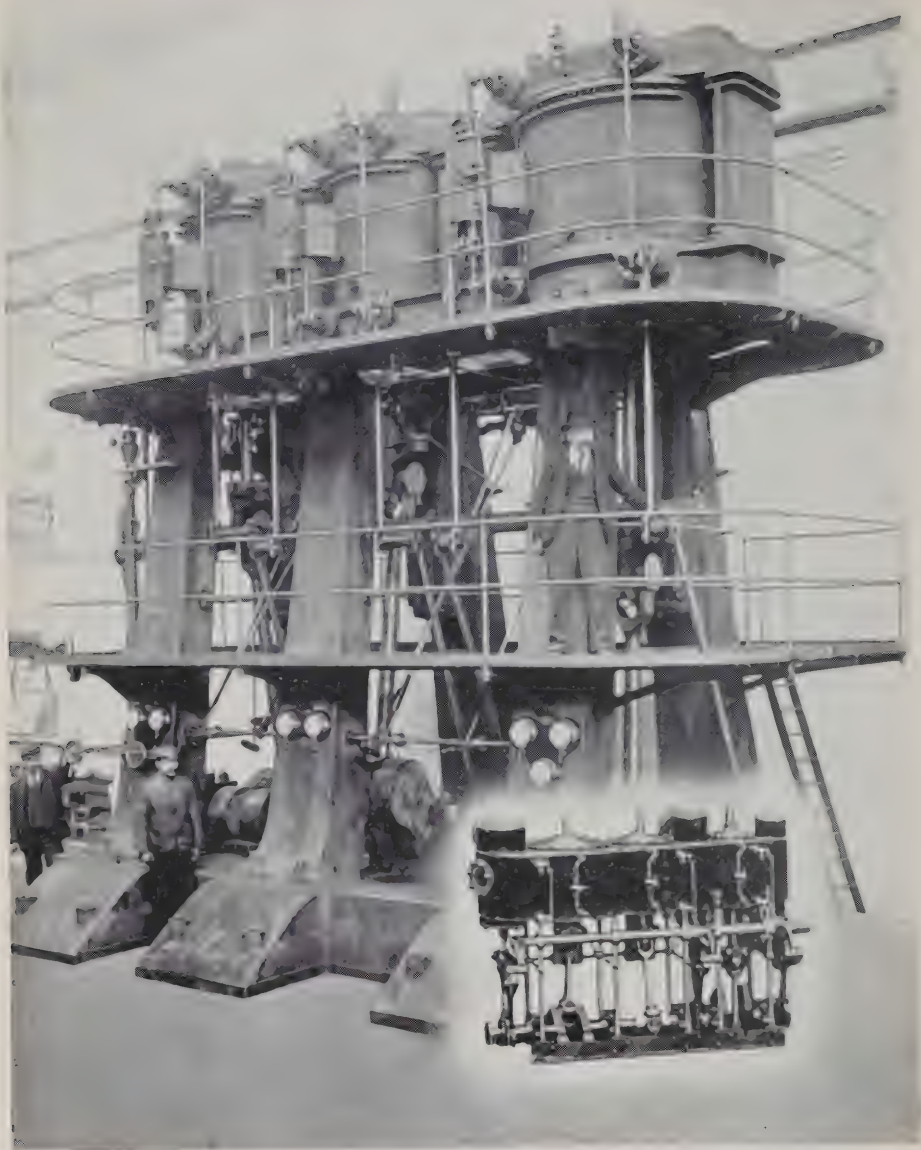
The reputation of the Yarrow firm was won by the speed of their vessels, and Yarrow on many occasions, in early days, actually quoted a lower speed than he knew to be obtainable, because he feared to lose the confidence of the authorities by suggesting a velocity which they would think impossible. By naming a speed within what appeared at the time the limits of practical engineering, he retained the confidence of all concerned, and in many cases the contract terminated with a substantial bonus when a speed was obtained in excess of what was promised.

Upon the question of speed, which led to so much experimental work, and which aroused so much interest among scientific shipbuilders, Yarrow always maintained that there was no special merit in an increase of speed if due to larger dimensions. When the engine power in a boat is augmented in the same proportion as the displacement, the speed is improved in accordance with Froude's Law, and it does not represent any scientific advance.

The present high speeds are mainly due to the following:—

1. The greater number of revolutions of the machinery, and the higher pressure of steam.

Had it been proposed in former times to allow an engine to revolve at from 400 to 600 revolutions a minute, combined with a boiler pressure of 250 lb. per square inch, this would have been looked upon as the wild suggestion of a lunatic, and it would have been impossible to find anyone ready either to design the machinery, or to work it. These high pressures and fast revolutions are now customary. The effect



DIGNITY AND IMPUDENCE

THE PROGRESS IN 30 YEARS. BOTH THESE ENGINES DEVELOP THE SAME POWER

of rapid revolutions and high pressure of steam is well illustrated by the photograph "Dignity and Impudence." Both these engines developed the same power, although so different in size.

2. The introduction of forced draught, which corresponds to the use of bellows upon a domestic fire, makes it possible to burn a greatly increased amount of fuel on a given area of grate, thus enabling the boiler of which the grate forms part to generate an abnormal amount of steam. The effect of this may be realized when it is stated that as much as 150 lb. of coal have been burnt on a square foot of grate in an hour.

3. The introduction of water-tube boilers, which again secures an increased generation of steam for a given weight.

4. The adoption of very high-tensile steel, which renders possible a substantial reduction of weight in the hull.

5. The introduction of steam turbines.

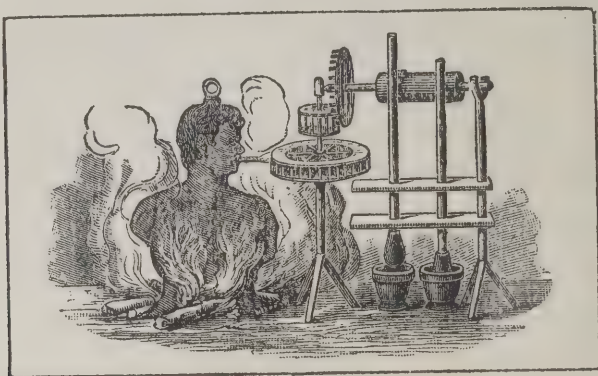
It will be seen that in the first four causes enumerated the gain is due to reducing the weight in a vessel of a given size and power—that is to say, a less weight has to be driven through the water, which clearly diminishes the resistance, and thereby augments the speed.

With regard to the introduction of steam turbines, a few words must be devoted to this important invention.

The subject is particularly interesting to shipbuilders, because, with the exception of the introduction of this form of engine, no development of any real importance in speed has taken place in the design of the torpedo-boat type of vessel and machinery since the days of the *Sokol*, which was completed in the year 1895, and which for the first time embodied

high revolutions, forced draught, water-tube boilers, and nickel steel.

The first steam turbine of any note was invented by an ingenious Scandinavian farmer for separating the cream from the milk in his dairy. The turbine actuated a cream separator, which was of necessity made to revolve at a very high velocity, so that the centrifugal force should be sufficient to drive the heavier part of the milk to the sides of the separator; the



cream, being the lighter constituent, finding its way to the centre. This revolving motion was obtained by means of a jet of high-pressure steam striking a kind of paddle attached to the separator. By degrees, after scientific investigations were brought to bear upon this device, the jet from which the steam issued, and the blades on the wheel against which the steam impinged, became modified so as to secure an increased efficiency, and it ultimately developed into what is known as the "De Laval" turbine, named after the inventor.

The first person to make a practical success of the turbine for ship propulsion was Sir Charles Parsons, who must for ever rank amongst our greatest practical scientists.

After the turbine had been introduced as a marine motor, it became evident that the reciprocating engine for some classes of vessels was doomed.

In this section, dealing chiefly with developments in torpedo-vessels, it has been necessary to devote a small space to the subject of high speeds, because it is now recognized that the speeds formerly demanded simultaneously by various Governments for vessels designed simply to carry torpedoes led compulsorily to experimental work, resulting in important improvements. Each such improvement, in order to increase speed, became quickly universal. Thus, step by step, the speed advanced, and this was not only the case in torpedo-boats, but in the mercantile marine, culminating in the record voyages of the great Atlantic liners. It should be recognized that a large amount of credit is due to the original pioneers and investigators, whose continuous researches have made the present high speeds, not only of warships, but of ocean liners, possible.

It is, no doubt, surprising to non-technical readers that there should be any connection between the scarcely habitable light craft for war which we have described and the huge palaces of luxury in which the wealthy traveller crosses the Atlantic ; but it may be stated, without fear of contradiction, that the fastest craft afloat at the present time is the torpedo-boat destroyer, and for the last thirty-five years the vessel attaining the highest speed on record at any particular time has always been one of this class. Every increase of speed, from 16 knots upward, has been first obtained by a torpedo-boat, and therefore it is not too far-fetched to say that the ease and swiftness with which voyages of every kind are now made, are due to the

mounting of the spar torpedo upon a small steam launch. Had it not been for the demand by various Governments with the all-important object of the defence of their country, for high speeds in torpedo-boats, and the determination of the engineers to meet it, the exceptional velocity now obtained would never have interested scientific men; for, from a purely utilitarian point of view, it would not have been deemed of sufficient importance to induce them to carry out the costly experiments which have resulted in the gradual attainment of the present results.

We do not wish to imply that those firms who have devoted themselves to the construction of small vessels have more ability than those who build large ones, but the record of progress from the very commencement of steam navigation shows that advances have first been made with vessels of small size, the reason clearly being that experimental research can be carried out with small vessels at an expense which is within the means of many firms, whilst corresponding experiments on a larger scale would involve too much financial risk.

It must not be thought that the important work done by other firms is overlooked, but it is generally conceded, as far as torpedo-boats are concerned, that the honour of their successful development rests with the three firms so long in friendly competition—Yarrow, Thornycroft, and the French constructor, Monsieur Normand—and these names will ever be associated in the evolution of high speed, from the earliest form of tiny pleasure launch to the thundering sea-going torpedo-boat destroyer of the present day.



LE STANLEY ON THE CONGO

LENGTH OVER ALL 84 FEET. BEAM 17½ FEET. DRAFT 18 INCHES

CHAPTER XIV

STANLEY AND THE CONGO

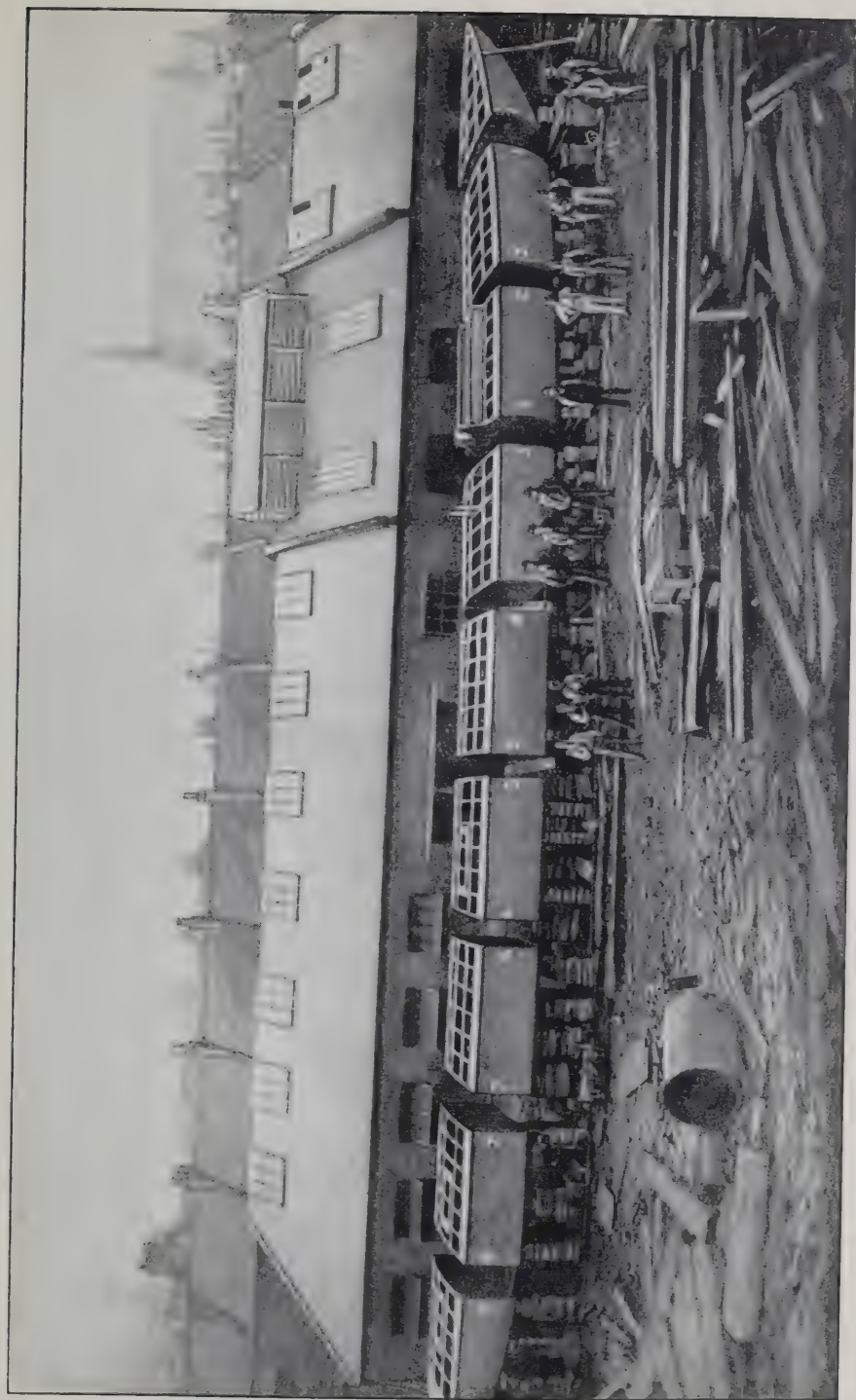
In building steam launches, Yarrow came into touch with explorers and missionaries anxious to penetrate into the interior of unknown lands, for the most part by rivers which had not hitherto been navigated. It was in many cases necessary to obtain vessels of exceptionally shallow draught, and Yarrow came to the conclusion that if it were known that he was prepared to build launches with a draught shallower than anything previously attempted, a demand would arise for such craft. In the year 1874, he inserted an advertisement in the technical papers stating that he was ready to undertake the construction of launches having a draught of not more than 6 inches, and within a week he received an order for a little boat, 50 feet in length by 8 feet beam, with a speed of 8 miles an hour, and a draught of under 6 inches—which at that time seemed incredible. No sooner was this launch completed than the firm received numerous orders for similar boats, some propelled by side-wheels and some by stern-wheels.

A famous steamer was built in 1883 for the King of the Belgians, who had secured the services of Mr. Stanley to explore the Congo. The river at that time being unknown, Mr. Stanley asked for a steamer which could be taken to pieces and put together as often as required, so that in unnavigable parts of the

river, or on meeting with rapids, it could be transported in pieces overland. This problem he submitted to Yarrow. It was clearly not practicable to have a vessel frequently riveted and unriveted, as that would soon ruin the hull, and something was needed much larger than the *Ilala*, which, it will be remembered, was bolted together and unbolted from time to time. Yarrow hit upon the device of constructing the steamer in floatable sections, each of a size possible to ship on to the deck of an export vessel, and for these sections, *while afloat*, to be united by bolts, so that when fastened together they made a complete hull.

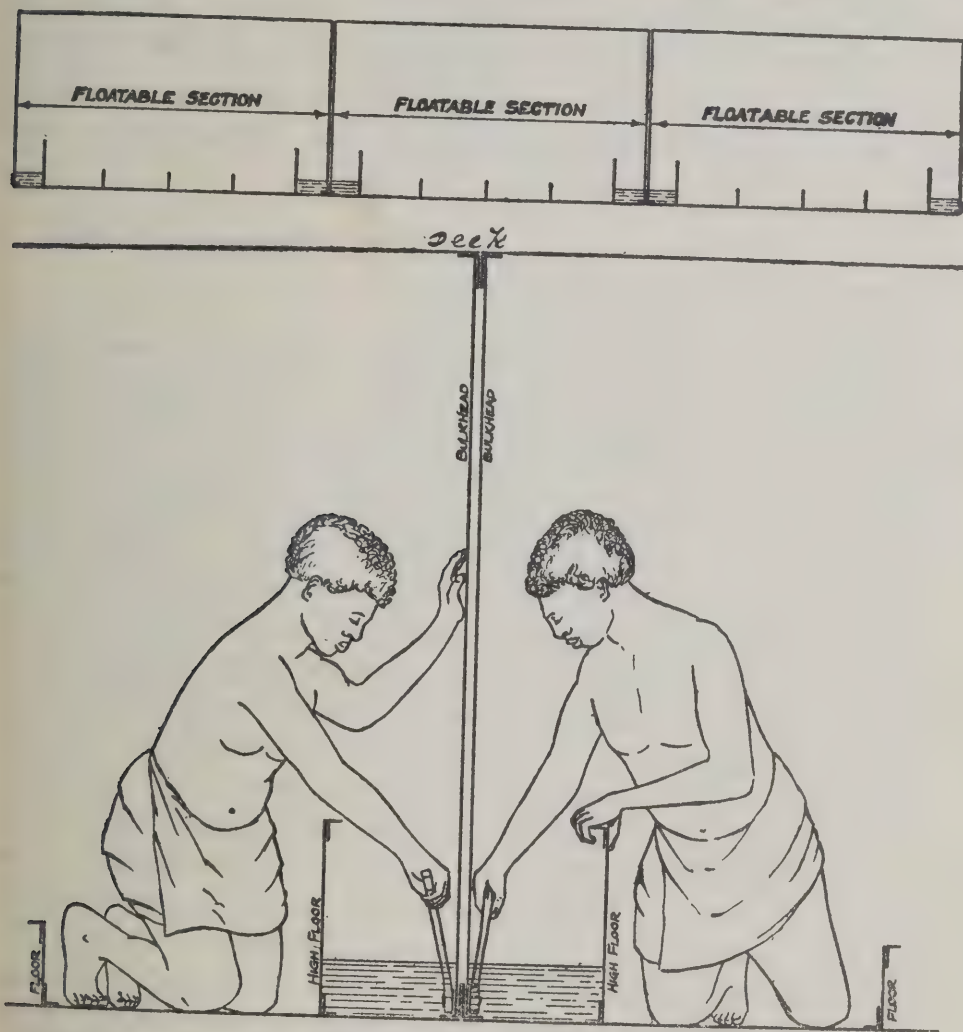
Each section was intact, with a bulkhead at each end, and was floated up to, and brought into contact with, the corresponding bulkhead of the next section. Bolts were then passed through the bulkheads all round the edge of the two parts, so that they could be securely joined together.

When a section came to be floated, however, a difficulty arose, for the water would pass through the bolt-holes near the bottom into the section, causing it to sink. To avoid this a vertical plate was placed a few inches from each bulkhead, leaving just sufficient space to allow a man's hand to pass down between the plate and the bulkhead. This plate was of such a height above the bottom of the hull that when water passed in through the bolt-holes it could not flow over the top of the plate into the body of the compartment. When the various pieces were brought together to be connected, the workman would pass his hand through the water and push the bolts into the holes in the two sections, and screw them up. When these were made tight, the water was pumped



STERN WHEEL STEAMER "*LE STANLEY*," SHOWING THE SECTIONAL CONSTRUCTION

out of the space between the bulkheads and the vertical plates. By this system the hull could be quickly taken to pieces, and put together as often as required. For land transport, four wheels were fastened under



METHOD OF CONNECTING THE SECTIONS OF THE HULL WHILE AFLOAT.

each section when afloat, forming a wagon which could be drawn up the bank. Similarly, the process could be reversed, for the sections could be run into the water, floated, the wheels removed, and the various parts united again. This procedure was carried out

whenever any part of the river became unnavigable, necessitating the boat being taken overland.

The success of this mode of construction led to a number of similar vessels being ordered from the firm.

On September 1, 1884, Mr. Stanley wrote to Yarrow a somewhat amusing account of the arrival of the little steamer (which was named *Le Stanley*) at the foot of the Congo Falls. An extract from his letter is given:—

“LONDON, *September 1, 1884.*

“MESSRS. YARROW & Co.

“GENTLEMEN,—*Le Stanley* arrived at the Congo from England about the same time I arrived at Leopoldville from the Stanley Falls. By the time I reached Vivi the sections had been screwed up, engine and boilers, with hurricane deck mounted, and within four days I was much gratified to see her one morning steam up in view of Vivi Station. No one could make her out for a time, and it was very amusing to hear her character guessed at by the crowds which lined the verge of Vivi Cliff. Some laughingly thought that she must be some strange fabric of Portuguese build destined to bombard Vivi. Others thought that she must be an English structure sent out by a Conservative Government to settle the Congo question; while others again predicted that she was French—the long-expected gunboat which was to ride over all the Congo Falls to the Upper Congo. As she drew nearer, and we noted the route she took, we became more assured, and finally we saw the flag of the International African Association, and then became convinced she could be none other than the new boat built by your firm.

“Though she steamed gallantly up and through the lower Vivi rapids, which has a current inshore even of 8 knots, she had a much more formidable work ahead in the section between Isangila and Manyanga, and I wished to test her powers thoroughly before ordering her to be dismantled. The chief engineer demurred slightly at this extra trial, on the ground that she was but temporarily put together; the captain in charge



A SECTION OF "L'E STANLEY" BEING TRANSPORTED OVERLAND PAST THE CATARACTS ON THE CONGO

supported him. Notwithstanding their very reasonable objections I insisted that her powers should be thoroughly tested on the lower river, before proceeding to expend £4,000 for her carriage overland, and for this test the upper portion of the lower river, which has a current of from 6 to 12 knots according as you are near shore or centre of river, was chosen for her run. I also gave orders that she should carry her own steel wagons, or trolleys, and all her own extra equipment and stores and planking, so that I could see what she could do heavily loaded via the rapids and whirlpools. She made four round trips of the aggregate length of 80 miles in the worst water of the Congo, in water that whirled the French gunboat, *Sagittaire*, when she attempted to come up to Vivi, round like a top. This work she did, remember, in a state that underwriters would have condemned as being unfair. I then decided that she was fit for our work, that if any accident happened it would be the fault of the navigators and officer in charge.

“What I admire about her specially is her small draught, her breadth of beam which gives steadiness and capacity for carrying cargo, and her twin rudders. I was quite astonished at their enormous power. One turn of the wheel instantaneously swept her bow clear of danger that a second before seemed imminent. The boat is an honestly built boat, with honest workmanship.

* * * * *

“Yours obediently,

“HENRY M. STANLEY.”

CHAPTER XV

GORDON AND THE NILE

In 1874 the firm's growing reputation for building boats to meet any emergency brought Yarrow into relation with the tragedy of the Gordon Missions to Khartoum.

We may remind the reader that for some years before that date the condition of the Sudan had been one of increasing unrest, constant disturbances occurring between the Egyptian troops and the mixed population in this large district. In 1874 the attention not only of the Khedive, but also of the British Government, had been forcibly turned towards the cruelties and barbarities exercised by the slave-dealers, and the Khedive (Ismail Pasha, the first of the Egyptian Governors who made any attempt to suppress the inhuman slave traffic) made a special request that General Gordon should proceed to Khartoum and assist as his diplomatic adviser in arranging various matters under discussion in the region of the Upper Nile.

General Gordon, having the consent of the British Government, undertook this task. As Governor-General of the Sudan (which included the Equatorial Provinces) between the years 1874 and 1879, his aim was to bring all the Sudanese provinces under a firm rule, and, when a powerful position should be established, to wage war against the

slave traffic, and to suppress it by every possible means.

In March of the year 1874, before Gordon had proceeded to Khartoum on his first mission, Yarrow was invited to call upon him at his lodgings in London. "Chinese Gordon" (as he was then called) had already acquired a world-wide reputation as a commander of courage and resource. He appeared to Yarrow a very quiet, unassuming gentleman, naturally keen about the work before him, and exceedingly anxious to obtain the fullest particulars as to the type of steamer which might prove most useful upon the Nile waters, so that, should he request the Government at some future date to send out such vessels, he would know exactly what to order.

Considering the sudds (i.e. great masses of floating vegetation) which in places rendered the Upper Nile almost unnavigable, Yarrow determined that screw-propulsion was out of the question, because the long weeds would become twisted round the propellers and would render them useless. Thus the choice lay between vessels propelled by wheels at the side and those driven by a wheel at the stern. The boats would have to be sent out in pieces, and the limit of the weight of each part would be determined by the load which could be carried across the desert on a camel's back. General Gordon took abroad with him full particulars of these steamers, which he believed would be needed, and Yarrow heard no more of the matter until many months later, when he was desired to visit a gentleman in London, who, it was said, lay in a dying condition. This was the Governor of the Equatorial Provinces, who had acted under Gordon. On returning home, this officer had passed through

Khartoum, seen Gordon, and been commissioned by him to interview Yarrow, and to ask that four steamers, the details of which had been previously arranged between them, should be dispatched without delay. This sick gentleman showed great anxiety to have the contract settled before he died, so that he might keep his promise to his chief.

The matter was accordingly arranged, and the contract hastily signed. The steamers were built, and sent out to Khartoum, being put together on the banks of the Nile. In 1879, when Gordon left the Sudan, at the termination of his first period as Governor, the boats remained there in the possession of the Egyptian army. After a lapse of some years, during Gordon's later mission, these little vessels came into prominence, being used to assist in the defence of Khartoum. They were also sent down the Nile to meet the relief expedition, and to bring up the reinforcements from Lord Wolseley's troops which had crossed the desert from Korti.

Thus the four boats were destined to be not only extremely useful to Gordon during his first term as Governor, but to bear an important part in connection with the tragedy of his subsequent mission in 1884.

Although so well known, it will be necessary to recall the sad story of General Gordon's second mission to Khartoum, because of the important work which brought Yarrow into touch with the Nile Expedition.

At the beginning of 1884 the British Government decided that the Khedive should withdraw his representatives and troops, and all those dependent upon them, from the Sudan, because the Mahdi and his

wild followers were gaining great power in that region, and to hold out against him would probably have resulted in loss of life, and expenditure altogether out of proportion to any possible gain. The controversies to which this withdrawal gave rise need not be here described, but it was determined by Mr. Gladstone, then Prime Minister, to send General Gordon upon this difficult and dangerous mission, viz. the evacuation of Khartoum by the Egyptian troops, and by those dependent upon this army for safety.

Gordon left London on January 18, and was welcomed in Cairo on the 24th with great enthusiasm. On February 18 he reached Khartoum.

Although he lost not a moment in commencing preparations to carry out his instructions, his stay in Khartoum extended over eleven months, during eight of which he was shut up within the walls of the city. In fact, after the month of March he could only have escaped as a fugitive betraying his trust, leaving the terrified population of mixed tribes, who had placed themselves loyally under his protection, unconditionally in the hands of the Mahdi and his fanatical Arab followers, numbering at the time probably about 5,000 fighting men, 1,000 of them blacks, and 150 Egyptians. Within a few weeks of his arrival it had become impossible for him to carry out his instructions to withdraw peacefully from the Sudan with 10,000 to 15,000 Egyptians and Europeans committed to his care. The peaceful possession of Khartoum had become a siege, and the following telegram from Her Majesty's Government to Lord Cromer in Cairo, with its reply from Gordon, dated July 31, describes somewhat tersely the actual situation at the time.

Telegram from H.M. Government.

“ We do not propose to supply him with Turkish or other force for the purpose of undertaking military expeditions, such being beyond the scope of the commission he holds, and at variance with the pacific policy which was the purpose of his mission to the Sudan ; that, if with this knowledge he continues at Khartoum, he should state to us the cause and intention with which he so continues. . . . ”

Answer from Gordon.

“ You ask me to state cause and intention in staying at Khartoum, knowing Government means to abandon Sudan, and in answer I say I stay at Khartoum because Arabs shut us up and will not let us out.”

At this point the position appears to have remained stationary until the Mahdi and his troops, reinforced by various tribes, closed round Khartoum, and the critical time, when the terrible tragedy might have been averted, was passed. This, perhaps, was not grasped by those at home. Cabinets met, arrangements of every possible kind were projected, telegrams of an extremely contradictory character passed between Westminster, Cairo and Khartoum, operations were continually postponed, and the River Nile, in full flood between July and September, gradually fell too low for carrying any substantial help to the unfortunate garrison.

It was early in 1884 that Yarrow's name and work became linked with this historical incident, and a few of his notes in connection with the events of 1884 and 1885, during which time he was constantly in touch with the War Office, are amongst the most interesting records of the firm.

The first intimation received that the work of the firm might be required, was a request from the Admiralty asking Yarrow what class of steamer, in his opinion, would be the most suitable to convey troops and stores up the Nile. He proposed vessels propelled by a stern-wheel, which he considered was the type least likely to come to grief in passing through the dangerous rapids, whilst another firm, simultaneously invited to send in their views, suggested a different system of propulsion. Not having heard anything in reply to his proposals, Yarrow called at the Admiralty and was told that the stern-wheel type of vessel was not deemed the most suitable, whereupon he sought an interview with Admiral Sir Cooper Key, then First Sea Lord. He gave his card to the messenger, who told him there was little hope of his seeing the Admiral, taking in the card only after a complimentary coin had been slipped into his hand. He was shown into the waiting-room, which was filled with distinguished naval officers, waiting their turn to see the Admiral, and, sitting down to read the paper, he awaited the course of events, determined to remain there all day if needful.

Much to his astonishment he was almost instantly sent for by Sir Cooper Key, who, after greeting him cordially, said he was the very man he wanted, and at once expressed the opinion that he did not like the method of propulsion advocated by his technical advisers, but preferred the simpler arrangement with a wheel at the stern. The Admiral asked a few questions and obtained all the information required.

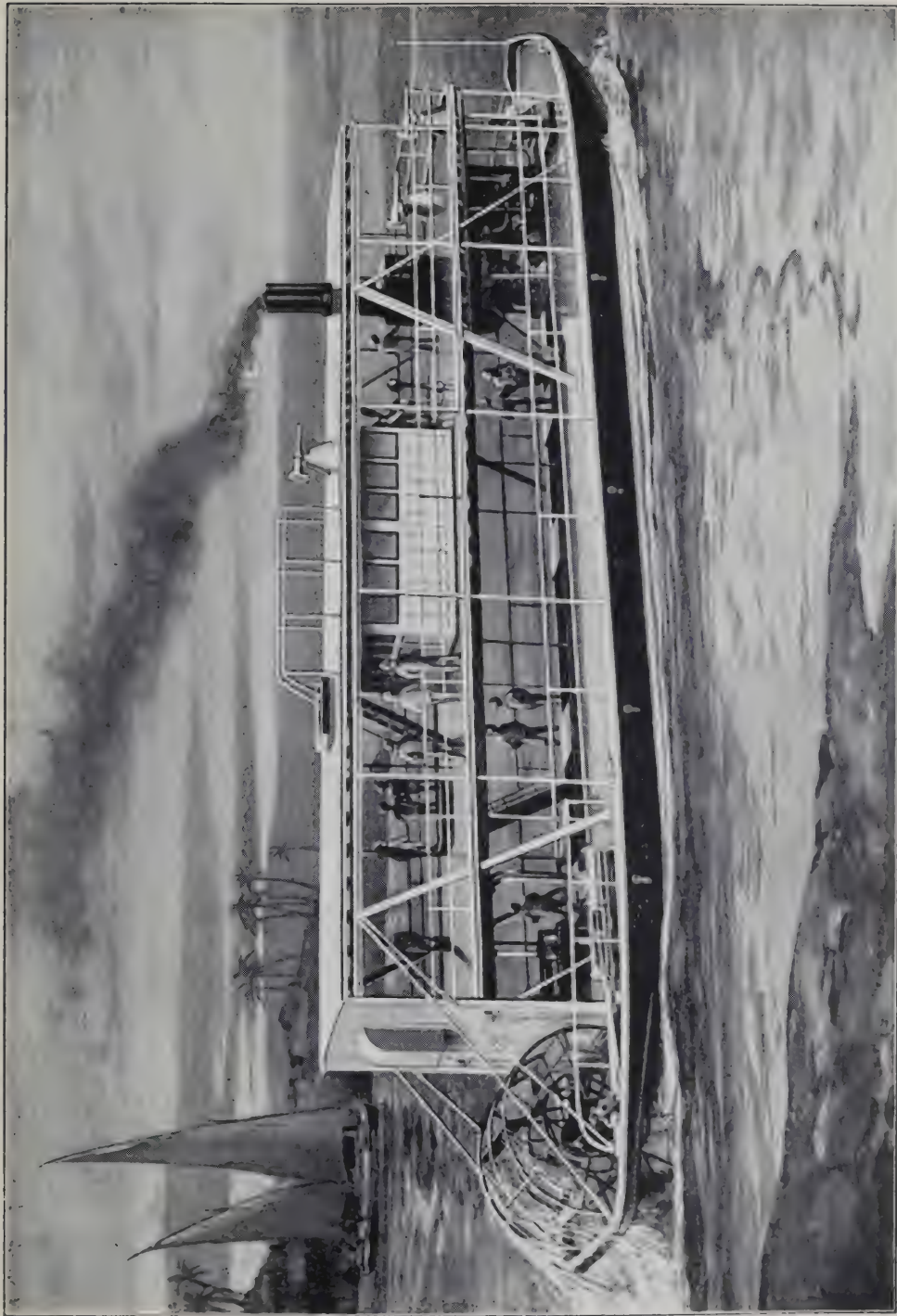
On reaching home, Yarrow found to his surprise a letter from Sir Cooper Key, telling him that he was appointed to assist Lord Wolseley to design the most

suitable vessels for the proposed Nile Expedition, which would be set in motion immediately on receiving the word of command from Mr. Gladstone, then Prime Minister. Lord Wolseley asked Yarrow to place himself in communication with various shipbuilders, so that a number, at least twenty, small stern-wheel steamers could be built from his design, with great dispatch.

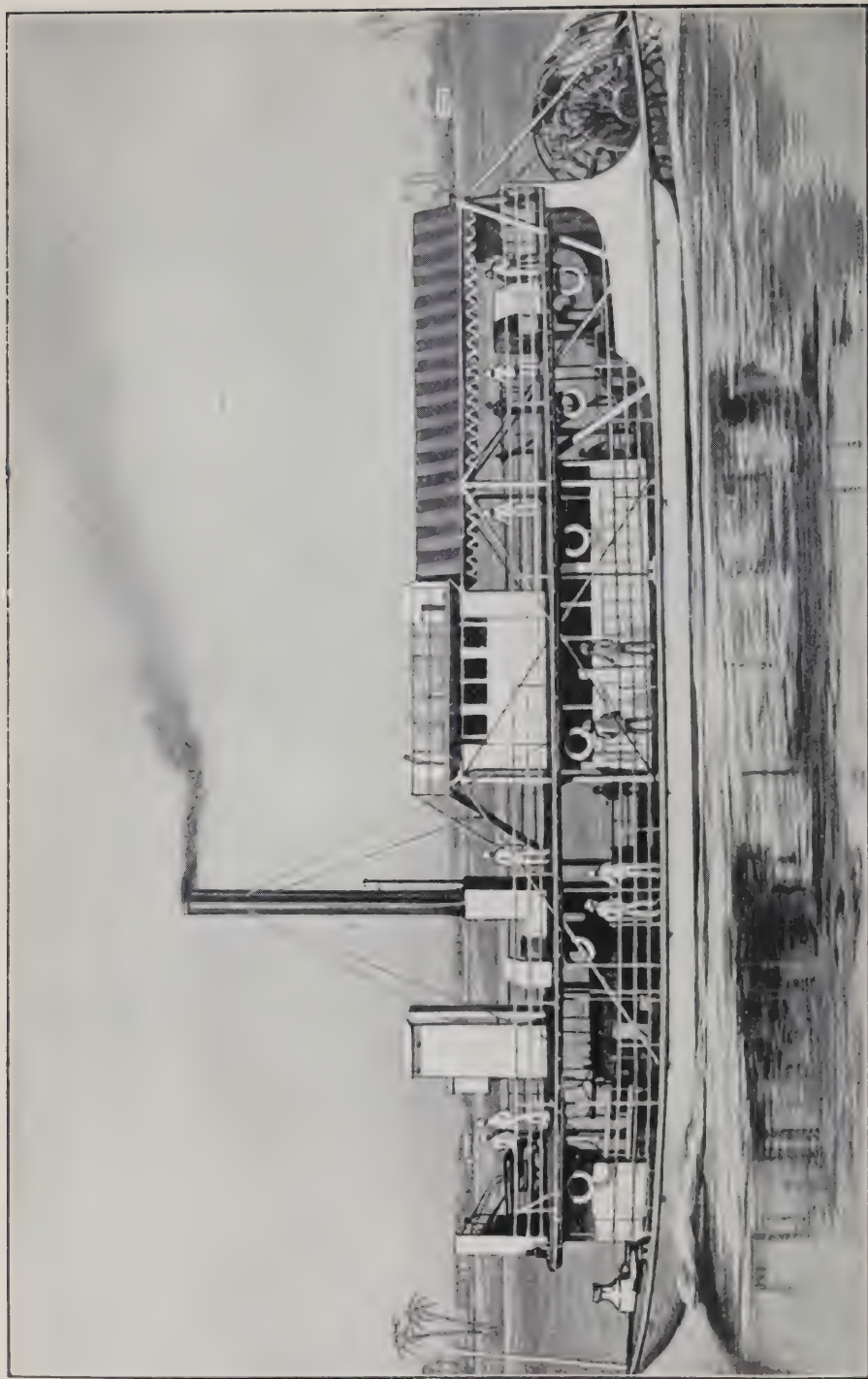
Yarrow arranged a complete scheme which would enable three leading firms to start building the steamers at a moment's notice, from a common design, on receiving orders to proceed. It can be easily appreciated that speed of construction was the first consideration, for in order to rescue Gordon, the Nile must be reached at a period when that river was sufficiently high to admit of safe navigation.

Yarrow had instructions to visit the War Office two or three times a week, so as to be well posted up in succeeding events. The summer wore away, and to Lord Wolseley's intense disappointment, for delay added materially to the difficulties of an already hard task, and to Yarrow's despair, for he recognized the futility of sending out steamers when the Nile had fallen too low for navigation, nothing was decided by the Government, and the scheme of building a number of steamers had to be abandoned.

In September, when all hope of navigating the river and ascending the cataracts with steamers was at an end, the Government decided to send out 800 rowing boats, which could be rowed through the quiet reaches of the Nile, and towed up from the shore by the troops and sailors where the river was most rapid. Yarrow advised the War Office to obtain the services of Canadian boatmen, because the



THE *LOTUS* ON THE NILE
LENGTH 90 FEET. BEAM 18 FEET. DRAFT 18 INCHES



STERN WHEEL ARMoured GUNBOAT ON THE NILE
LENGTH 99 FEET, BEAM 18 FEET

ascending of cataracts requires certain expert knowledge which British seamen have no opportunity of acquiring. Consequently, by the time the rowing boats were finished a large contingent of Canadian boatmen was sent direct to Egypt.

On April 8 a memorandum had been addressed to the Government by Lord Wolseley, discussing the position of affairs, and the route which it would be advisable to take. Lord Wolseley had stated at this juncture: "Time is the most important element in this question. . . . I recommend immediate and active preparations for operations that may be forced upon us by and by."

On August 26, 1884, Lord Wolseley was appointed to command the expedition, his instructions being to bring away General Gordon and Colonel Stewart from Khartoum. On October 5, he arrived at Wady Halfa, and the Nile Campaign may then be said to have definitely begun.

The end of it is known to every one. The expedition was too late! Khartoum had been entered by the Mahdi, after a siege of 317 days, a few hours before the relief steamers arrived. The tragedy was over. Gordon was dead.

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It happened that in the autumn of 1884, at the time when the 800 rowing boats were ordered to provide means of transport for the expedition up the Nile, the Yarrow firm had a stern-wheel steamer, the *Lotus*, on the point of completion for South America. She was immediately purchased by the Government, hoping that she might possibly arrive in time to assist the expedition. When completed, the *Lotus* was

shipped to Egypt in pieces, transported overland, and put together at Semneh towards the end of 1884, above the great cataract at Wady Halfa.

It was intended that this stern-wheel steamer should steam above the second cataract as far as was found practicable. She started from Wady Halfa on January 9, 1885, made a most remarkable passage up to Korti, and, although she was unfortunately sent out too late to assist the relief expedition in ascending the river, yet she was invaluable during the withdrawal of the troops after the tragedy of Khartoum.

The *Lotus* was commanded by Lieutenant Stanhope, assisted by two Canadian pilots, and, contrary to all expectations, successfully steamed through several cataracts and the numerous intervening rapids between Wady Halfa and Korti. After the most perilous experiences of twenty-six days' river navigation, she suddenly appeared, on February 4, 1885, at Korti, to the great astonishment and delight of Lord Wolseley, who needed assistance badly at that time to withdraw his troops. No one acquainted with that portion of the river ever dreamt that a boat of the size of the *Lotus* could accomplish this piece of navigation during the lowest condition of the Nile. From this time she was used as a floating hospital to take down the sick and wounded, returning with barges full of stores in tow. Her speed was about 5 miles an hour against the stream, and 13 miles with the stream. From her shallow draught we read that the *Lotus* was invaluable as a means of transport on the return of the troops to the Lower Nile, for with this exception steam navigation had long since been closed on that portion of the river. In passing up the rapids, under the direction of the Canadian pilots, she was propelled by her own

steam. Ropes fastened to her bow and reaching to both sides of the river-bank were hauled on by a large force of men, the object being to keep the bow facing upstream. Without this controlling influence the vessel would have been swung round by the force of the current, and would undoubtedly have been wrecked. It was in this mode of guiding the bows of vessels passing up rapids that the expert knowledge of the Canadian boatmen was found so valuable.

A second steamer, an exact copy of the *Lotus*, had been ordered from Yarrow, named the *Waterlily*; the contract stipulated that she should be finished ready for shipment within six weeks, and, to the great satisfaction of the War Office, she was completed in the incredibly short time of seventeen days, and sent off to Egypt.

There were a few other small steam launches on the Upper Nile about this time, but these came to grief, and at one period Lord Wolseley's communication between Cairo and Korti was dependent solely upon the Yarrow boats *Waterlily* (between Assuan and Wady Halfa) and *Lotus* (between Wady Halfa and Korti).

Although these little steamers were deprived of their crowning success by being commissioned too late to save the nation's hero, yet after-events show the valuable work carried out by them.

From *The Standard*, February 4, 1885.

“HEADQUARTERS, KORTI.

“*Tuesday.*

“The Yarrow boat *Lotus* arrived here to-day with a full cargo, having made a very rapid passage. From her speed and comfortable arrangements the *Lotus* will be invaluable as a

means of transport for invalids between this place and the Lower Nile.”

From the *Daily Telegraph*, February 5, 1885.

“The Yarrow stern-wheeler has reached Korti safely, having easily passed the Third Cataract and the succession of rapids between there and Wady Halfa. With this exception, steam navigation has been long since closed on that portion of the Nile, owing to the low state of the river.”

The success of the *Lotus* and *Waterlily* led to five boats of the same type being ordered from Yarrow by the Government. Subsequently three more stern-wheel steamers, fitted up as armoured gunboats, were sent out from Poplar. These were shipped in floatable sections, and not in small pieces as previously, the object of this change of construction being that on arrival in Egypt the various sections should be lowered into the river and joined together while afloat, as in *Le Stanley*, thus saving considerable time in re-erection. These gunboats, which were heavily armed, were intended to prevent the Mahdi, who was rapidly gaining power, from coming nearer to Egypt than Wady Halfa.

On Lord Wolseley's return to this country, he wrote to Yarrow as follows :—

HAMPTON LODGE, FARNHAM.

3rd August, 1885.

“DEAR SIR,—In acknowledging the receipt of your letter of 24th ultimo, I must express my regret at having missed seeing you when I was in town last week.

I have great pleasure in informing you that both the *Lotus* and *Water Lily* were a great success. They were not perfect, but nearly so, and the alterations in design required to have



HAULING A YARROW STEAMER UP THE RAPIDS OF THE NILE

made them perfect for work on the Upper Nile, were few and simple. I described those alterations in my correspondence with the Secretary of State for War, and I sent home Lieut.-Colonel Alleyne, R.A., and Chief Engineer Benbow, R.N., to see those alterations carried out in the other boats you were building for us. I presume you have seen both those officers. The stern-wheelers lately sent to Egypt are admirable, they have been put together under the direction of Colonel Ardagh, R.E., at Cairo, and my only regret is, that, for the present at least, we are not to use them in helping forward the military operations they were designed for.

“Very truly yours,

“WOLSELEY.

“To A. F. YARROW, Esq.”

CHAPTER XVI

THE YARROW HINGED FLAP

About 1892 a new system of propulsion in connection with shallow-draught vessels was, under some conditions of navigation, taking the place of the side-wheel and the stern-wheel types. It consisted of propellers working in tunnels constructed underneath the hull. This was an old scheme of some unknown genius who never enjoyed the credit due to him.

In modern times the efficiency of this plan has been greatly augmented, and made a success, by the introduction of the Yarrow Hinged Flap. It should here be explained that screw-propellers were hitherto unsuitable for vessels of very shallow draught, as the diameter of the screw, being limited by the draught, rendered it impossible to use any but small propellers, which were not of sufficient size to absorb the power necessary to obtain a high speed. With the device about to be described this difficulty is overcome, and a propeller of large size in combination with a shallow draught is obtainable.

Let us imagine a tumbler inverted, and the edge of it placed a little way below the surface of some water in a basin; then by some means let the air in the tumbler be exhausted. It will be evident to all who have the most meagre scientific knowledge that the water from the basin will rise up and fill the interior of the tumbler, rising to a higher level than

the surface of the water in the basin, and filling the vacuum which has been created. Now, assume a flat-bottomed boat, with a portion of the bottom scooped out in the form of an arch, so that the upper part of the arch is well above the level of the surrounding water. If this scooped-out portion could have the air exhausted from it, it is self-evident that the water surrounding the vessel will rise up into this cavity in the same way that the water would rise in the inverted tumbler. Assuming the top of the scooped-out part is semi-circular in cross-section, it will be quite a suitable hollow for a screw-propeller to work in, the top of the propeller being arranged to clear the top of the scooped-out part or tunnel. Now, if the propeller thus located be made to revolve rapidly, it will force the air out of the upper part of the tunnel, and water will fill the space. So long as no air can gain access to the interior of this tunnel there will be a sufficient body of water for the propeller to work in, for it will by its movement suck the water up from the forward part of the cavity and eject it out at the stern. By this system it is possible to have a large propeller working in a sufficient body of water in combination with a shallow draught.

It is self-evident that water ejected from the propeller in a sternward direction, striking the inclined surface of the upper part of the arch, causes an appreciable resistance to the forward motion of the ship. By means of Yarrow's Hinged Flap, which can be raised and lowered according to the draught of the boat, this resistance is reduced to a minimum. As a matter of fact, when once the propeller is working and the water rushing out in a sternward direction, the flap can be lifted up considerably above the level of the water in which the boat floats, as no air can gain access

to the tunnel against the rush of water passing outwards.

If the flap is allowed to be free, its position automatically adjusts itself.

In 1897 the Admiralty determined to have six shallow-draught gunboats for use in different parts

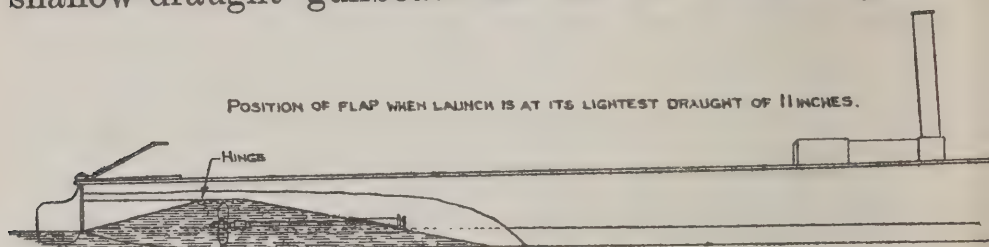


FIG. 1.

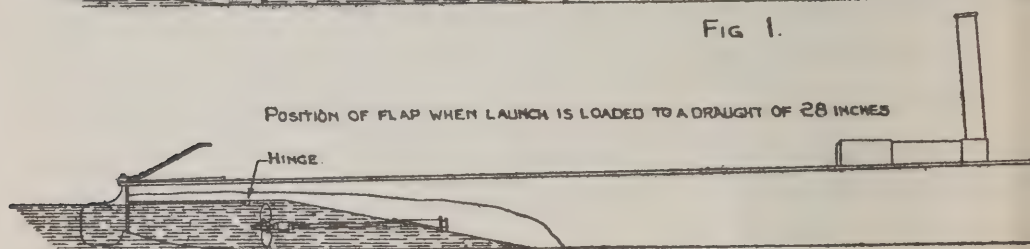


FIG. 2.

of the world, and the proposal made by the Yarrow firm for vessels with screws working in tunnels was considered the most acceptable. The gunboats (Heron type) were shipped in floatable sections, on the same plan as that introduced in *Le Stanley*.

In 1896 the question of the reconquest of the Sudan was seriously discussed by the British Government, with the result that in 1897 another Nile Expedition took place under Lord Kitchener, and once again some Yarrow boats went out to see active service. An order was placed with Yarrow for the *Sultan* and the *Sheik*, two gunboats with screws in tunnels. These vessels did useful work at the taking of Khartoum on September 2, 1898 (see *Cromer's Egypt*, p. 105).

In 1903 the *Widgeon* was ordered by the British Government for the navigation of the Yangtze-



STERN OF A LAUNCH SHOWING THE HINGED FLAP



THE *SHEIK*

LENGTH 145 FEET. BEAM $24\frac{1}{2}$ FEET. DRAFT 24 INCHES



THE *WIDGEON*

LENGTH 160 FEET. BEAM $24\frac{1}{2}$ FEET. DRAFT 27 INCHES. SPEED 15 STATUTE MILES AN HOUR

Kiang, and an extract from the report of Captain Plant, the expert navigator of this river, is of interest :—

“ You will be both pleased and interested to know that the *Widgeon* has lately made a very successful passage from Ichang up the Yangtze-Kiang to Chungking in the record time of six days. In addition to this, she has given by far the best results at the rapids of any vessel up to date. She steamed all the rapids *en route* easily, without having recourse to wire hawsers from the shore.

“ One vessel only, H.M.S. *Woodlark*, ever succeeded in ‘steaming’ all the rapids, and then only by waiting about until a friendly freshet gave the favourable opportunity, the passage in her instance occupying thirty days to the *Widgeon*’s six, which speaks volumes in favour of the latter. The *Widgeon* has at least $1\frac{1}{2}$ knots to the good of the *Woodlark*, but I consider where rapids are concerned it is not that extra speed which has made the difference. It is undoubtedly the absence of all resistance at the after end of the ship, which is done away with by the hinged flaps, that has given the better results. The *Widgeon* was never more than a minute and a half in negotiating any of the rapids.”

The improvements which have been made in the construction of shallow-draught vessels during the period with which this short story deals, may be summarized as follows :—

(1) The introduction of water-tube boilers combined with forced draught, which resulted in a great saving of weight, equally necessary where either shallow draught or high speed is required.

(2) The plan of sending vessels abroad in sections which are floatable, and arranged so that they can be united together in the water, avoiding the tedious process of riveting and launching.

(3) The adoption of the Yarrow Hinged Flap, in combination with screws working in tunnels.

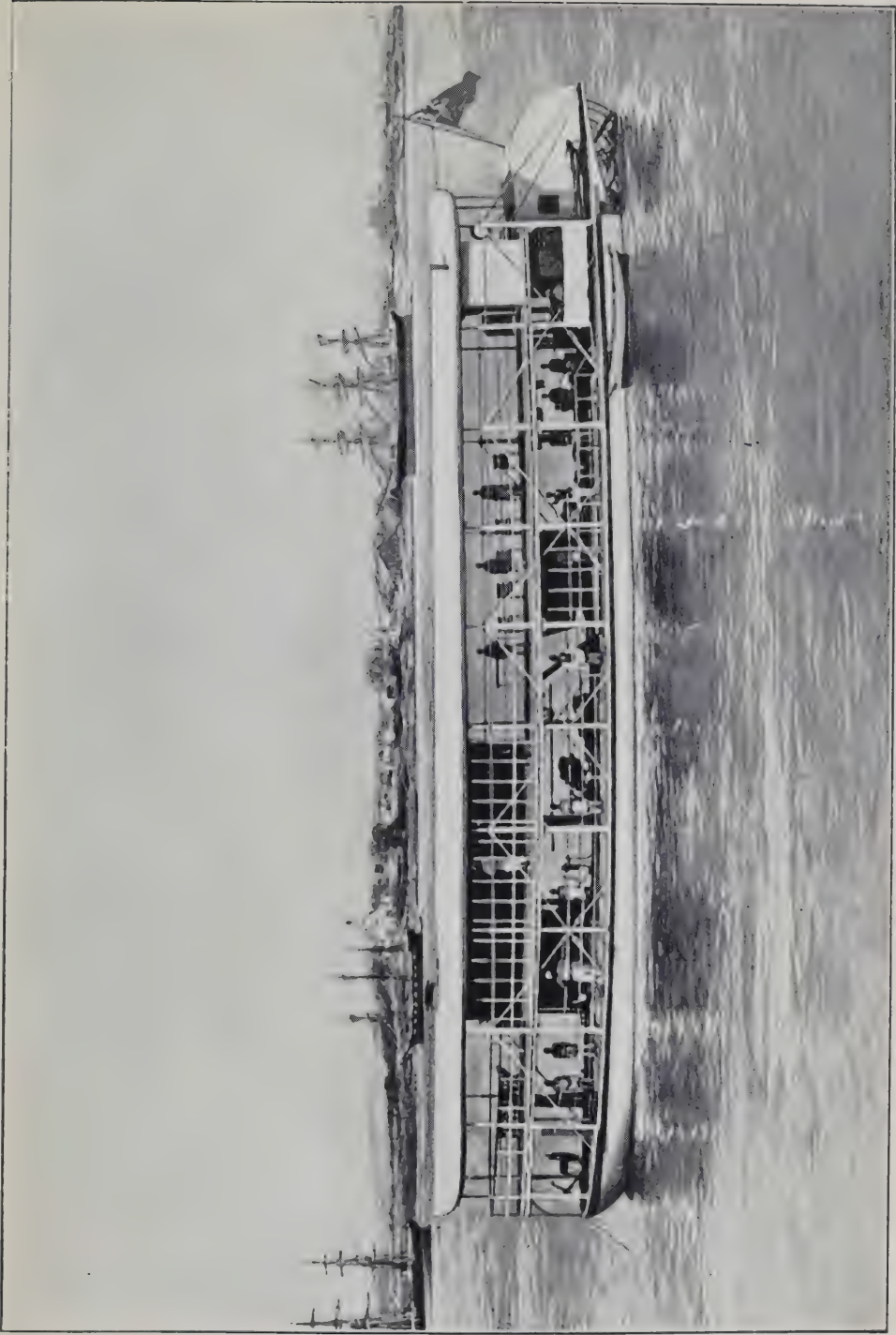
CHAPTER XVII

INTERESTING BOATS AND INCIDENTS

Among the early stern-wheelers one was built in 1876 for the King of Burma, who was so pleased with his new toy that, to prevent anyone else making use of it, he always had the safety valve and the steering wheel taken back to the Palace after each trip, and they even reposed by his bed at night.

In conjunction with Messrs. Siemens the Yarrow firm built, during the year 1883, one of the earliest electric launches, the current being obtained from storage cells placed in the bottom and under the seats of the launch. At this time it was impossible to foresee what developments might take place in the application of electricity, and it was quite within reasonable possibility that this means of propulsion might become commercially practicable. The launch was an exhibit of special interest at the Vienna Exhibition of 1883, making numerous trips on the Danube, and, although only 40 feet long, she had no difficulty in stemming the stream of that swift river.

It must be borne in mind that at this period the utilization of electricity for illuminating purposes, for driving tram-cars, and for transmission of power, was quite in its infancy, the only tram-cars driven by this means in the United Kingdom having been started in Portrush the previous year.



THE KING OF BURMA'S RIVER STEAMBOAT

LENGTH 120 FEET. BEAM 20 FEET. DRAFT 12 INCHES. SPEED 13 MILES



ONE OF THE EARLIEST ELECTRIC LAUNCHES

Many shallow-draught vessels have been built by Yarrow and shipped in pieces to the interior of countries difficult of access. The following extract, with its accompanying photograph, taken from a letter written by the engineer in charge of a Yarrow steamer which had to be transported in pieces across the Andes, gives a vivid idea of the troubles incidental to traversing mountain passes :

“Since the revolution there is neither money, mules, nor labourers. An arrangement was come to with the Government to hire thirty-five prisoners, most of whom were murderers. Having arrived at the foot of the mountains, it was impossible to ascend except by carrying the shaft on the men’s shoulders. I thus got to the highest point on the road, which is said to be the highest pass in the world. The spectacle was indeed horrible. Most of the poor fellows had their shoulders swollen black and blue, and in some instances the skin was cut and the wounds open to the bone. I enclose you a photograph of the scene representing the paddle-shaft being carried by the convicts. In the rear are ten Colombian soldiers with loaded guns ; then comes a man on horseback. He is sent to act as paymaster. The man standing before the shaft, with his face towards the river, which flows beneath, is an officer of the guards. He has a sabre in his hand very much like a bread-knife. The next person on horseback is the jailer, with a whip in his hand, of which he makes use when the prisoners do not walk to his liking. Lastly, you see myself on horseback.”

The illustrations of the *Ibera*—a stern-wheeler built by the Yarrow firm which capsized in a hurricane on the Alto Uruguay River—are good evidence of the force of storms which occur in some latitudes. The official report of the incident was as follows :—

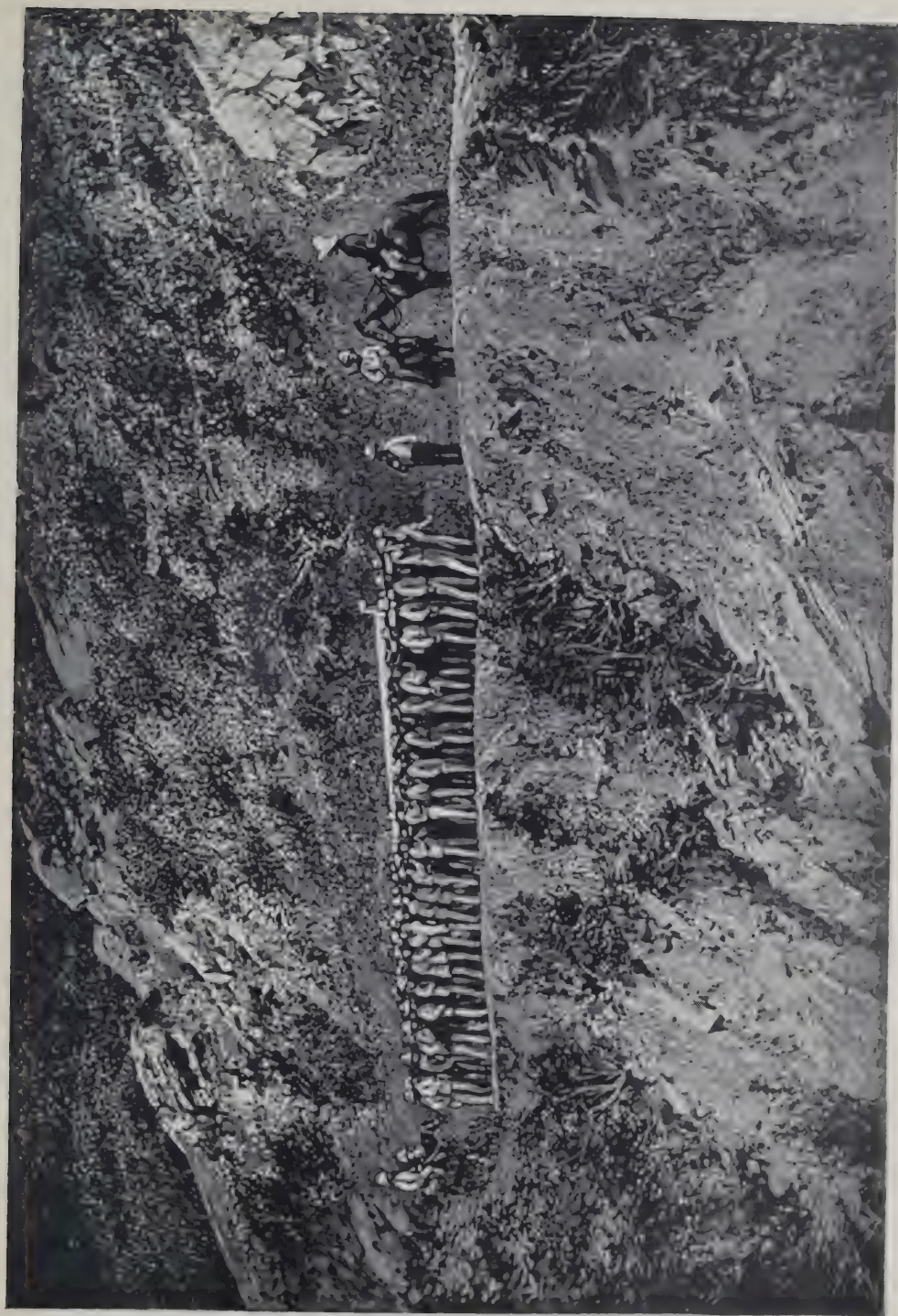
“The *Ibera* had just discharged her cargo, and in expectation of bad weather we had doubled all her connections to the shore. The first gust snapped these like pack-thread, and the vessel

was blown bodily three hundred yards out into the river, heeling over all the time, until she settled down on her port side. The whole catastrophe did not occupy three minutes. The force of the wind rendered it impossible for the crew to do anything but hold on for dear life, and it was only after the storm abated somewhat they were taken up by the Custom House boat. Three days ago we floated her again. During the same storm the roof of the railway station was blown off."

In 1890 came a period when strained relations existed between the British and Portuguese Governments in connection with the navigation of the Zambesi. The point at issue was whether the Zambesi should be open to all nations on equal terms, or whether the Portuguese, who owned the banks on both sides, should be able to enforce dues. The interests of the British Government in the interior were such that they naturally wished to have free means of communication, and did not feel inclined to have any further toll or duty imposed upon their traffic beyond paying a fair share towards what was necessary for maintaining the Zambesi in a navigable condition.

At this time Yarrow was building some gunboats ordered by the Portuguese authorities for that river.

After considering the position taken up by the Portuguese, and realizing that they would shortly have gunboats on the river, our Admiralty determined to take steps to enforce the British demands, and it was proposed to send out a number of armed launches. Yarrow was consulted as to their design, and he told the authorities that, taking into consideration the size of the Portuguese vessels which were being built in his yard, and the unhealthiness of the climate for those who might have to sleep on board, which would, if launches were adopted, necessarily be near the surface



A PORTION OF A STEAMER BEING TRANSPORTED OVER THE ANDES



THE *IBERA* BEFORE THE STORM



THE *IBERA* AFTER THE STORM

of the water, the scheme proposed was scarcely one that commended itself to him. Asked to suggest something better, he proposed stern-wheelers in floatable sections of the same type as *Le Stanley*, which could be transported to the mouth of the Zambesi, lowered into the water, and put together at the side, and under the protection, of the vessel which took them out. In this way the authorities would be quite independent of help from the shore, which, under the circumstances, the Portuguese could hardly be expected to concede. Having explained to the Admiralty exactly the class of vessel which he proposed to construct, Yarrow undertook to build two such steamers in six weeks, conditionally upon his having a perfectly free hand in the design, and not being subject to the delay inseparable from Admiralty control. He also undertook to prove by experiment that the various parts could be put together on the Thames (essentially under the conditions to be met with at the mouth of the Zambesi), and that the vessels should be ready to start, with steam up, in twenty-four hours from the commencement of the re-erection. The order was given, and the two gunboats, the *Mosquito* and *Herald*, were finished in the record time of twenty-five days.

Before shipment, the Admiralty demanded that a test should be made to ascertain the time needed for putting one of the steamers together. So that this should be proved by actual experiment, and that no possible attempt should be made by those in charge of the work to continue the erection during the intervening night, when no one representing the Admiralty would be on the spot, an inspector was sent down with portmanteau and bedding to sleep in a warehouse

alongside the boat. Everything was delivered on the quay in the West India Docks for the purpose of the trial erection. The inspector arrived one morning at six o'clock with his portmanteau and his bed, prepared to stay two or three days till the steamer should be put together. The pieces were placed on the dock-side in a manner which should correspond with the conditions to be met with when the parts should arrive on the transport at the mouth of the Zambesi. To the surprise of everybody, the vessel was completely erected, the engines and boiler fixed in their places, all pipes connected, and in six hours forty-five minutes the *Mosquito* steamed out of the dock into the Thames. The trial was in every way successful, and as the utmost haste was required to effect the shipment, the dismounting began soon after lunch. In the course of the afternoon, some distinguished officials from Whitehall went to the docks to see what progress was being made, and, to their astonishment, they were told that the "exhibition" was over, and the boat was being taken to pieces for shipment. Needless to say, the inspector did not have to unpack his bed or portmanteau.

In the year 1892 the French Government gave the Yarrow firm an order for the shallow-draught stern-wheel gunboat *Opale* for service in Dahomey.

Prior to this Yarrow had experienced somewhat shabby treatment from the French Government. The French Admiralty had ordered from French contractors for use in Tonquin some stern-wheelers which turned out unsuccessful. They then applied to Yarrow to construct others in their place. The



THE MOSQUITO

design, price, and specification were agreed upon, and Yarrow only awaited a message from the Minister in order to proceed to Paris to sign the contract. The expected telegram was duly received, and Yarrow and his wife started immediately for France, the next morning having been fixed for the signing of the contract. As the order promised to be a profitable one, Yarrow suggested to his wife that she should choose some jewellery for herself, and very naturally she made the purchase without delay. The following morning, when he attended at the French Admiralty, the Minister expressed regret for being unable after all to place the order with him, and offered him a cheque for £250 to cover his expenses in preparing the designs and in coming to Paris. This was declined. Yarrow told the Minister that he came at his request to sign the contract, and he hoped His Excellency would see his way to proceed with it. The Minister replied that this was not possible, whereupon Yarrow referred to the fact that several stern-wheelers for Tonquin had been built in French yards, and owing to their bad design had proved unsuccessful, which was the cause of the Minister inviting proposals from him. He also remarked that it was not fair to induce him to submit detailed designs embodying the experience of many years, under the promise of an order, because these drawings gave all the information needed, and would not have been sent unless a contract was practically assured. The Minister replied that he would give back the designs, and immediately sent for them. They were brought and placed on the table, and Yarrow then asked the Minister whether he knew what the four little holes at the corners of each drawing indicated. The Minister expressed his

complete ignorance, and Yarrow replied that he could inform him that the pin-holes showed that the drawings had been copied ; therefore, the actual return of the designs did not mean the return of the information, which was retained and worth a great deal more than £250. The moral of this journey to Paris, remarked Yarrow, is twofold :—

(1) Not to trust Governments with detailed designs embodying special knowledge.

(2) Not to buy jewellery for one's wife until a contract is settled, or, better still, executed, and the profit (if any) ascertained.

In this connection Yarrow often commented upon the different methods of procedure of various Governments ; and as an illustration he pointed out how badly a foreign Naval Commission—composed of gentlemen of eminence—behaved in 1909. It appears that they obtained designs from firms all over the world for battleships, selected what in their opinion were the best qualities of each proposal, and then asked for further designs, embodying the information they had thus obtained for nothing. In this way the Commission not only received valuable knowledge, but distributed it broadcast among competitors. This form of “ education ” without any payment whatever, and obtained through the inducement held out of a possible contract, cannot be looked upon in any other light than as a kind of authorized robbery.

As an example of entirely different procedure on the part of another Government, Yarrow frequently referred to the honourable way in which the Austrian authorities behaved when some torpedo-boats and destroyers were built for them by his firm. These

were to be taken as samples for similar vessels, if successful, to be duplicated in their own ship-yards.

The Minister of Marine in Vienna would not allow the Yarrow boats and their machinery to be copied by the Austrian shipbuilders without stipulating that a fair remuneration should be paid for the use of the designs.

As another example of interesting dealings with various Governments, the following incident may be related. One day Yarrow was walking through the streets of Paris when he met Monsieur De Bussy, the distinguished Chief Constructor of the French Navy. This gentleman showed the pleasure he felt in meeting his friend by a cordial embrace, and immediately proceeded to explain the great trouble he was in owing to several boilers having given way in vessels which he had designed, so that none of them were successful on their official trials.

He explained to Yarrow that the failure was due to the leakage of some screwed stays at the sides of the boilers, and owing to the boilers being packed so close together in the ship, it was impossible for a man to get between them and stop the leakage.

It is perhaps of interest to explain what these stays are like. The boilers in question were similar to the boilers which are in use on railway locomotives, only much bigger. *Fig. 1* shows two of these boilers side by side. One of these boilers is shown in section through the fire-box and the other boiler is shown as it would appear looking at the fire-door end of the boiler. These boilers were so big that it will be seen they had two fire-doors instead of only one, as is usual

on a railway engine. Inside the inner fire-box is where the fire is placed and between the inner fire-box and the outer fire-box is the space for the water which is to be turned into steam. Owing to the pressure of the steam it is necessary to have stays or screwed pieces of metal holding the inside and the outside together, otherwise the flat plates of the fire-boxes would bulge when steam was raised.

Monsieur De Bussy explained to Yarrow that these stays at the side of the boiler were the ones which were



FIG. 1.

giving trouble, and in one of the ships they actually had to take the boilers out to get these repairs effected. He added that the affair had been noticed in the newspapers, which was very mortifying to him, but he did not see how the difficulty could be permanently overcome without completely re-arranging the boilers in the ships, so that every part should be accessible. Of course it was quite impossible for a man to get down between the boilers in order to do any work on the stays, as will be seen.

It might here be added that on a warship, owing to naval officers requiring the highest possible speed, the

boilers are made as large as possible, and placed very close together, so that there was nothing unusual in Monsieur De Bussy's design, the trouble being that the leaky stays could not be repaired.

Yarrow came to the rescue of his friend and said he had a device by which this trouble could be overcome without moving the boilers or attracting

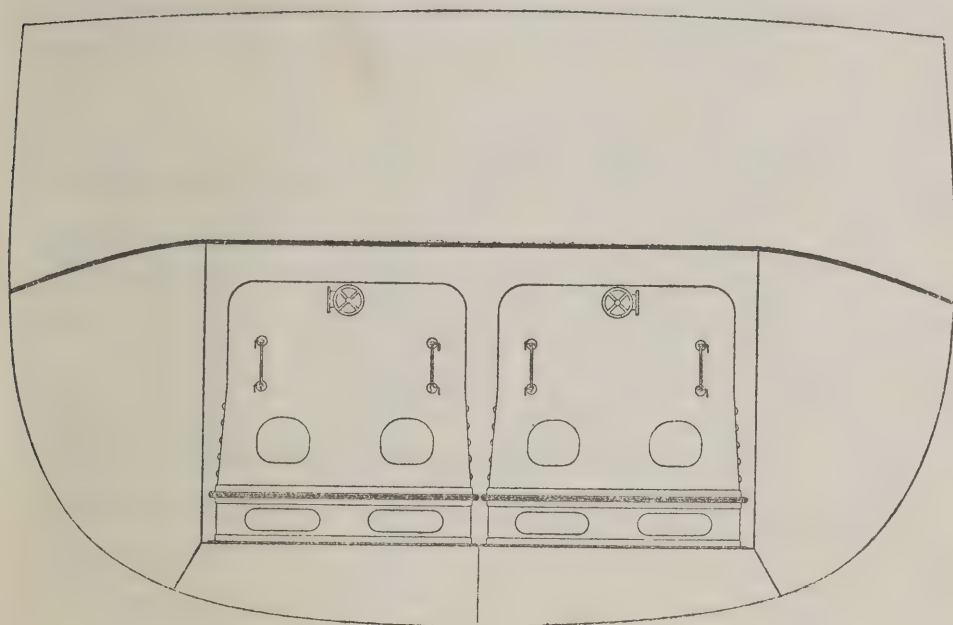


FIG. 2.

attention, whereupon Monsieur De Bussy embraced him *à la française*, and marched him off to the Ministry of Marine to explain his plan. Yarrow's proposal was to adopt a special form of hollow water-space stay, such as is shown in *Fig. 3*. A water-space stay with a hole through it was well known, and the usual practice was to make the hole through the stay of the same diameter throughout. When the stay was screwed into the two plates of the boiler, a man drove a tapered steel rod or drift into the hole in the stay

and expanded the metal of the stay so that it fitted tightly into the boiler plate. Where there was plenty of room, as in a locomotive, the workman drove the drift into the stay, first working from the outside of the boiler, and so expanded the stay in the outside plate, then he went inside the fire-box and drove the drift into the hole in the other end of the stay so as to expand it in the inner boiler-plate. To meet the present difficulty, where it was impossible for the man

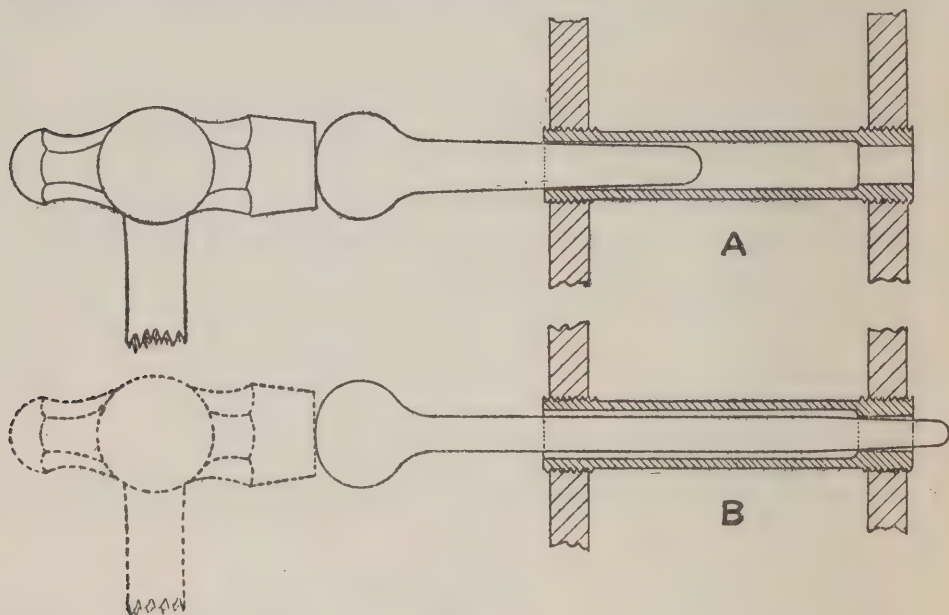


FIG. 3.

to work on the outside of the boiler, Yarrow proposed that the hole in the stay should be smaller in diameter at the part where it was screwed into the outside plate than elsewhere, so that all the work could be done from the end of the stay inside the fire-box.

On looking at *Fig. 3* it will be seen that when these special hollow stays are screwed into the two plates, it is a simple matter first of all to expand or drift the end of the stay which is screwed into the inside fire-box, the operation being shown at A. It is then

necessary to expand the stay at the other end. This is done by taking a long drift, passing it through the larger part of the hole in the stay, until it comes to the smaller part as shown at B. The drift is then hammered into the smaller part and owing to its being tapered, it expands the stay so as to make it also a tight fit in the outside plate of the fire-box.

What was new in this idea was the method of expanding the stay at its outer end, although operated from the inside of the fire-box. It is obviously necessary to have the larger part of the hole big enough to allow the drift to pass through into the smaller hole.

Monsieur De Bussy at once realized that Yarrow's proposal saved the situation, as it avoided the necessity of working at the stay on the outside of the boiler where there was no room available, and that everything could be done from the inside without removing the boilers. So great was his confidence in Yarrow that he asked him to take the matter in hand at once and put the boilers in one of the vessels in working order. This Yarrow agreed to do, and one of his staff, with a party of mechanics, went over to Cherbourg Dockyard. As might be expected, there was a certain amount of jealousy felt by the French workmen, who were naturally annoyed at the coming of the British to put their work in order, but owing to the cordial support of Captain le Clerc, who was in charge of the Dockyard, the repairs were brought to a satisfactory conclusion, and, after the new stays had been put in, the first successful official trial took place and Yarrow earned the warmest gratitude of the French authorities.

A shallow-draught launch was built for the West Coast of Africa, and a man who will be referred to as "D." was sent out in charge of the boat. Letters were at first received regularly from him, but suddenly they ceased. Some time afterwards two young women called at the factory, dressed in black, one of them in widow's weeds. They were ushered in, and the one dressed as a widow said she had come to tell Mr. Yarrow of the death of her husband. Yarrow naturally asked what evidence she had of this sad event, at the same time expressing his sympathy. Mrs. D. said she had a letter from her husband, which she handed to Yarrow, and which read something like this:—

"MY DEAR,—When you get this I shall be no more.—Yours affectionately,—D."

The inference to be drawn from this letter, as Yarrow pointed out, was that the husband was alive at the time the letter was written. Expecting some such reply, Mrs. D. produced another letter, from the doctor on a British warship, in which he said that her husband was suffering from some serious illness, and that he could only last a few hours.

Yarrow replied that this also was no evidence of D.'s death. But at any rate, these facts, together with a long silence, led to the assumption that he really was dead. As a result, a subscription for the widow was raised. It amounted to a considerable sum, given partly by his fellow-workmen, and partly by the firm. This money was expended as judiciously as possible, under Yarrow's guidance, for the benefit of the widow and her children.

Some years afterwards a man called at the works



Princess
Victoria.

Lord Fisher.
Mr. J. G. Yarrow.

King of Spain.
King Edward.

Queen
of Spain. Alexandra.

Motor Torpedo Boat.
King Edward's party on board.



and asked to see Yarrow. This was D. ! He stated that he wanted a job, whereupon Yarrow asked him how it happened that he had come to life again, because he had been "dead" some time. He told him a subscription had been got up for his widow, and it was generally supposed he was now in the next world. Yarrow also asked why he had not informed his wife that he was still alive. D. replied that he thought it best to "leave well alone." Yarrow refused to give him employment, saying he was afraid of men who died and came to life again.

Later on D. actually did die, and his widow again asked for a subscription to be raised for her, using the previous occasion as a precedent !

A small launch built by Yarrow, and propelled by internal combustion engines, was seen careering about the Solent during the Cowes Week in August, 1906.

Lord Fisher telegraphed to Yarrow that His Majesty King Edward expressed a wish to see the boat perform some manœuvres. The following day the motor-launch came alongside the royal yacht, and King Edward, Queen Alexandra, Princess Victoria, and the King and Queen of Spain, accompanied by Lord Fisher, made a short trip. The King suggested that the boat should be driven at its highest speed, but Queen Alexandra added hastily: "No, not whilst the King is on board. Do not run the slightest risk. I will go again later." After King Edward and some of the party had left the boat, the Queen had a further trip at the maximum speed, the little vessel travelling at a rate previously unknown in a craft of so small a size.

The internal combustion engine as a motive power

has this enormous advantage over steam, viz. that it can develop a given energy with much less weight ; and in cases where exceptional speeds are required this form of engine, using petrol, opened up a new and interesting field for the naval architect.

The remarkable speed obtained by this particular launch was in a great measure due to the fact that the bottom of the hull was perfectly flat, and when travelling at a very high speed was actually lifted on to the surface of the water instead of passing through it. In this way the resistance was enormously diminished.

CHAPTER XVIII

THE ENGINEERS' STRIKE, 1897

Towards the close of 1896 it became evident to both masters and men in the engineering world that a general conflict between them was impending.

In the spring of 1897 the Amalgamated Engineers, a Society which comprises the greater part of the skilled mechanics in this country, sent a demand to the London employers that the working hours should be limited to eight instead of nine for the same wage, the men's idea, which they did not conceal, being that they should first carry their demands to a successful issue in London, and then pass on from one district to another; that is to say, this powerful Society collectively would attack the districts individually.

Upon the employers receiving this notice, couched in very peremptory terms (the men demanding an immediate reply under threat of a strike), a meeting of the master engineers in London was held at Westminster. Its importance was evidenced by the large attendance, and, after a preliminary discussion, the motion was put that a reply, not expressed in very courteous language, should be sent to the men, stating that no such concession could be agreed to.

Yarrow said he was unable to agree with the motion, because, in the first place, he never liked to be on the losing side, and there was no doubt that the masters would get the worst of the conflict if such a course

as that proposed were taken. He said the firms in the North of England were at the time very busy, and the men would have no difficulty in finding employment; consequently there would ultimately remain only two courses for the London employers to adopt, viz. to shut up their works, or to accede to what was demanded.

In the second place, he pointed out that care must be taken to have public opinion on the masters' side, which would not be the case should the discourteous letter suggested be sent. He added that he considered the proper plan was to send a suitable and courteous acknowledgment to the men, if possible one that would carry with it public approval: that the letter should state that the matter was of so grave importance that an answer could not be given at such short notice, but a reply would be sent as soon as their request had been fully considered.

This course was ultimately agreed to, and Yarrow followed up his suggestion by proposing that a committee of two or three gentlemen from the meeting should be appointed to visit the East Coast firms and ascertain whether they would co-operate with the London employers in resisting the unreasonable demands of the men. He thought there was a probability of their so doing, because at that time they were experiencing much trouble with their men in connection with the working of automatic machines.

In order to reduce the cost of production, so as to be in the best possible position to compete with foreign firms, the East Coast masters required one man to attend to two or three automatic machines, which were of such a character that when once started they simply required to be watched from time to time,

not involving on the part of those in charge any greater exertion than they could reasonably be expected to give. The engineers, on their part, foolishly protested against one man working more than one machine, although it was freely admitted that he could easily do so. Consequently there was perpetual friction.

Simultaneously, there had been many labour disputes on the Clyde, and a Society was about to be formed by the employers there, to make common cause.

Negotiations therefore were set on foot in the first instance by the London masters to gain the co-operation, in their difficulties, of employers in other parts of the country, and these proved successful. Colonel Dyer, of Messrs. Armstrong & Co., took the matter up with indomitable energy, and thus came into being the Federation of Employers throughout the kingdom, which agreed to defend any individual member if the men went out on strike.

Many attempts at compromise were made, but the men insisted upon their demands. The consequence was that very soon a strike was commenced in some districts, and a lock-out in others. With a few exceptions, the masters were unanimous in their action, and consequently no work was executed except such as could be carried on by apprentices, labourers, and a few engineers who did not belong to the Societies.

As is usual during a strike, the principal difficulty to be met with on the part of the employers was that those who continued to work were subjected to ill-usage from the strikers, picketing being common. A number of the men would stand about the factory gates and attempt to molest those who would not join them in the strike. Police protection was not given.

Thus the echoes of the great Jubilee celebrations of the record reign of Queen Victoria had scarcely died away, and we were still congratulating ourselves on the progress and civilization of our Empire, when this struggle, so disastrous to the industry of the country began.

No unpleasantness had occurred between Yarrow and his men during the firm's existence, and the present crisis was a great worry to him. He had never been involved in strikes and lock-outs; he had always respected the working man and desired his welfare; but when it came to the men dictating how the masters should manage their own works, he felt that things were going too far. His men had struck without a word of quarrel with him. On the evening when they left, numbers went into the office, some even with tears in their eyes, to shake hands with their Chief, and to express their regret that things had come to such a pass.

How to carry on the work in hand, to enable those to continue with him who were so inclined, was a serious problem. The following advertisement was inserted in the press, with the result that an almost unlimited number of men applied for work:—

WANTED.—To Non-Unionist Fitters, Turners, Machine Hands, Drillers, Hammermen, Steam Hammer Drivers, Milling Machine Hands, Engine and General Smiths, Pattern Makers, and Joiners. An excellent opportunity is offered to intelligent apprentices just out of their time, improvers and others, who are seeking constant employment. The usual trade rate of wages will be paid during the first month, and then according to merit and zeal. Upon the Royal Mail Steamer Southampton, now moored opposite the works, new hands can be comfortably quartered out of the reach and the annoyance of pickets. Efficient men now engaged will at all times have the preference to others, and on no consideration will Unionists take their places in the future.—Apply by letter, stating age, experience, where last employed, and wages received to Messrs. Yarrow & Co., Ltd., Poplar, London, E. Applications will be dealt with in the order of their receipt.

To overcome the danger of letting the men enter

and leave the works by the usual gateway, Yarrow bought the Royal Mail Steamer *Southampton*, just as she had completed her final trip from Jersey. Forty-eight hours after the purchase, she steamed up the Thames and anchored off the works. Fitted up as a floating hotel, she provided accommodation on board for those who were willing to continue to work, so that they were out of reach of the pickets. Two members of the staff were in charge of the ship, and alternately lived on board during the strike, which lasted six and a half months. No pains were spared to make everybody comfortable. A code of rules was drawn up, and a large number of men from all parts of the country took up their abode on board. Every man was at liberty to leave the vessel whenever he chose, and he could be ferried to the shore. A religious service was held every Sunday by the Rev. D. G. Cowan, the vicar of the church on the Isle of Dogs, at which Yarrow and his family were present. A library of 300 to 400 books was placed on board, and entertainments were frequently arranged, so as to make the stay of the men as pleasant as possible. A doctor was in attendance twice a week, without charge to the men; ambulance classes were held, and some of the men gained certificates. A unique collection of indoor games was provided, and one day, when the men mustered on deck, Yarrow asked them whether anything further could be added to their comfort. The reply was that a set of boxing-gloves would complete their happiness, and these were soon supplied.

A launch was always in attendance to take the men to and fro. It was never known until they started to what pier they would be taken, nor where it would

be stationed for the return journey, for if this information had reached the pickets a large body would have been in attendance to ill treat them on landing, or to prevent them from re-embarking. It was the custom, when fresh men were engaged, to interview them at an office in London, where interference was impossible on account of police protection, and then to take them on board the launch, which met them at some pre-arranged pier. In this manner the works were kept going to a fair extent during the entire time of the strike.

After the last service, when the strike was over, the men asked Yarrow to make a presentation, on their behalf, to the Vicar, as a token of their respect for him, and appreciation of what he had done for them.

During the latter part of the strike, Yarrow thought his time would be well occupied in going to the United States to study the conditions of labour in that country. While there, he pointed out to American tool-makers that they had an exceptional opportunity to send over a supply of labour-saving machinery, which could be worked by unskilled hands. They grasped at the idea, immediately appointed agencies in various parts of this country, and advertised largely in the technical press. The result was that a great increase took place in the number of automatic machines imported, and, once set working, they have never again been dispensed with.

At this period matters appeared to be drawing to a close, and numerous conferences took place between the representatives of the masters and the men. Yarrow telegraphed from Boston, U.S.A., the following

offer, which was published in *The Times*, but it was not accepted:—

To the Editor of the Times.

Sir,—An extended tour through the New England engineering district in the United States has impressed me with the facts that the most perfect labour-saving machines are universally adopted; that the engineers have far higher wages and live in greater comfort than in Great Britain. In spite of the higher wages, the cost of production in many cases is less than in Great Britain, and before long the most severe competition from the United States will have to be met.

I believe the engineers now on strike are not fully informed of the rapid progress being made in other countries, and they might find an important object-lesson from a visit to the States.

So as to confirm or refute my own observations, I will willingly defray the expenses of a committee of three or four engineers of undoubted skill and intelligence who, prior to the strike, had been in constant employment for a lengthened period with first-class firms, which committee should visit the engineering centres extending from Boston to Philadelphia and prepare a statement concerning the results which have accrued to the American workman and record their actual social and financial position.—Yours, &c,

A. F. YARROW, of Poplar.

Boston, Mass., U.S.A.,
Jan. 4 (by telegram).

This proposal influenced public opinion, showing, as it did, the desire of the employers for their men to ascertain how serious competition was becoming, and how much more readily men in other countries facilitated reduction of cost so as to promote business.

The strike which had commenced on July 13, 1897, closed on January 31, 1898. The men returned to work on the old terms, but the loss to the country can never be estimated. The national misfortune was not limited to the actual loss in reduced production, for business which then went into foreign hands has remained there, whilst our men are out of work.

Throughout the strike, Yarrow expressed the opinion on many occasions that he knew the men were not lacking in good and kindly feeling towards him. He believed that they were actuated by legitimate motives in demanding better terms of employment, but he also maintained that the men's range of observation and knowledge was naturally extremely limited, and that they had but few opportunities of ascertaining the rapid advance being made in other countries, or of realizing the injury which the strike was doing to their own interests, and their country's. He fully approved of Unions, so that workmen may have the means of combining together for their common good, just as various commercial undertakings, such as railway and steamship companies, often combine to avoid excessive competition—a competition which, as it frequently leads to unprofitable working, cannot be for the general benefit.

The views he expressed may be summed up as follows :—

If a combination of workmen is to be to the advantage of the community, it is essential that the men should select as representatives level-headed individuals of strong personality, who are not dependent for their livelihood upon the salary paid to them by the men they are asked to lead, for it is important that they should not be under the orders of the men, if these want to take action contrary to their leaders' convictions or to what has been definitely agreed to by their representatives.

When a strike takes place it often leads to the hooligan class ultimately taking an active part, resulting in riots and sometimes bloodshed, and a legitimate striker then finds himself associated with

numerous bad characters, and has to bear the blame of their actions.

Workmen are entitled to get as much for their labour as they can, but they would act more wisely in their own interests, when they have a request to make, if it were couched in courteous terms, and never should it be accompanied by anything in the form of a threat. On the other hand, in any negotiations which take place between the masters and their workmen, it would be well if the employers would treat the men with proper courtesy, and, above all, avoid adopting an overbearing and pompous manner towards them. Yarrow often said that both masters and men might with great advantage take some lessons in manners. He used to relate that when serving his time in engineering works he was at first accustomed to raise his hat when meeting his employer in the street, but he soon abstained from this polite practice because the only recognition he received was that the gentleman in question would look up in the sky, as if he were taking some astronomical observation, or gaze vacantly on the other side of the road.

In discussing labour questions with his men, Yarrow often expressed the following opinions :—

It is well known that the cost of house property has gone up greatly within recent years. This is largely due to the increase in wages paid to those who are occupied in house-building. Now, if a man who makes bricks strikes for 25 per cent increase in his wages and gets it, if the man who builds the walls strikes for 25 per cent increase and also gets it, if the man who puts on the roof, the man who mines the slate in the slate quarries, the joiner who lays

the floor—if the workmen in all these various trades employed in house-building should strike successfully for 25 per cent increase in wages, the natural consequence is that the house will cost 25 per cent more when complete, and it is clear that this increase will have to be paid by the owner, who will require at least 25 per cent more rent, which increase the workman taking the house has to pay.

In the same way other necessities of life will increase 25 per cent if those who are engaged in producing them obtain a similar increase in their wages.

The result of this change will be that those who have obtained, by striking, an additional wage as measured in money, when they exchange the money for the necessities of life, will find themselves in the same, or possibly a worse, position than before the strike.

This process has been going on steadily for years. Wages have been gradually rising, and as a consequence the cost of living has increased.

It is perfectly legitimate and proper that every one having a spark of ambition should hope for a rise in position and an increase in wages, but the true and only way of securing this is for each worker to make his services worth more.

The benefit that a trade gains when a strike is successful is that it secures a temporary advantage over other trades.

Finally, Yarrow often said that if political economy—that is, if the natural laws which govern the value of labour, and of which masters equally with men appear to be in ignorance—were taught in our schools, it would certainly tend to diminish labour troubles.



The Cintra taking the King and Queen to West India Docks.

Many eminent people, both British and foreign, have at various times called upon Yarrow to discuss labour questions. Among these may be mentioned Mr. Balfour, when First Lord of the Treasury, whose sincerity and keenness about the industrial difficulties of the country forcibly impressed him. The King of the Belgians, who at one time feared labour difficulties in his own country, spent an afternoon at the works, and, after a chat with the head of the firm, interviewed some of the workmen, and showed a sympathetic interest in the difficult problems which arise between employer and employed.

On one occasion our King and Queen, then Duke and Duchess of York, had arranged to be present at a swimming competition in the West India Docks. Yarrow, hearing of this promised visit, offered to bring the party down the Thames from Westminster in one of his small torpedo-boats, but a few days before this engagement the engineers' strike was declared, and the men refused to drive the engines. Several gentlemen on the technical staff of the firm volunteered for this work, and the trip passed off successfully.

CHAPTER XIX

THE MOVE FROM LONDON TO GLASGOW

At the beginning of the present century it became a serious consideration whether London was really a suitable centre for the permanent home of the works, on account of economic conditions which rendered the cost of production there greater than elsewhere.

It is looked upon as a serious undertaking for the ordinary householder to remove his home from one place to another, but the moving of a huge factory from the banks of the Thames to the River Clyde—a distance of over 400 miles—is indeed a colossal operation, and perhaps it would be of interest to mention some of the considerations which led Yarrow to make this decision.

The essentials to economy in manufacturing are: the selection of locality for the works, the distribution of the shops on the site, the design and construction of the buildings, and the suitability of the various machine tools to their work. In addition there is the efficiency of the personnel, in connection with realizing recognized wants, initiative, and design of the productions.

One can easily imagine the many discussions which took place for and against the move. Colouring every argument was the dislike of tearing up old



SCOTSTOUN WORKS

associations which had been formed in many cases during more than half a lifetime.

There were, however, hard facts to be faced, and the dominating cause for this migration from London was undoubtedly the socialistic tendency of municipal government, with the consequent heavy rates and increasing cost of living. Thus, apart from direct expenses in connection with the works, the rate of wages in the Metropolis had to be higher than that paid for equally efficient labour in the provinces, without anyone profiting in the balancing of household accounts.

The final argument used by Yarrow was: "It is evident that shipbuilding on the Thames is a waning industry, and if we imagine that we are cleverer than other people in overcoming adverse conditions, we make a mistake; we must move while we can to some district where shipbuilding is growing and thriving."

The rumour of Yarrow's intention soon spread, and invitations were received from all parts of Great Britain and from abroad, because authorities realized that he was not starting a new business, but would bring with him an established industry, which would add prosperity to the district and give employment to a large number of men.

Over 400 invitations were received from mayors, town councillors, chairmen of dock boards, and others, many of them offering land free of cost, and using every inducement to persuade the firm to locate their works in the particular district in which they were interested. Many of these invitations were of a comical character, and the affair became caricatured in the newspapers, from which cuttings are shown.

The Clyde¹ was chosen after exhaustive inquiries into the possibilities of various districts, and in selecting the site at Scotstoun all kinds of influences were taken into account. One advantage of the Clyde is the unequalled measured mile at Skelmorlie for the

A POP(U)LAR TRAVELLER.



CHORUS OF PORTERS : " Carry your bag, sir ? "

(The great shipbuilding firm of Messrs. Yarrow & Co. are removing from Poplar, London, and enterprising municipalities in the North are making overtures to secure its establishment in their midst.)

trial of fast vessels, due to the freedom of the course from interference by tidal currents and storms and on account of the great depth of water near the shore. The proximity of the works to the iron and coal

¹ This account has been kindly contributed by Mr. W. Marriner, one of the Directors of the Yarrow Works.

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districts was also important. There were two railway lines within a few yards of the site, ensuring reasonable rates for the transport of material. The rainfall records were examined over a long period of years, and Scotstoun, probably because of the configuration

HAVING A TRY



(Councillor High has been in correspondence with the Messrs. Yarrow regarding removal of their Shipyard to the Tay, and has been impressing on them the advantages of a Dundee site.)

of the hill country adjacent, showed to better advantage than other districts within a few miles of the site selected. The ground was suitable for the foundations of the necessary buildings. The Clyde is wide enough for launching the longest vessels, and when one

remembers that the largest battleships and cruisers in the British Fleet have navigated the reach of the Clyde on which the works were to be situated, there could be no doubt that the waterway conditions were suitable.

Perhaps the greatest attractions were the warm welcome which Yarrow received from the ship-builders on the Clyde, and the far-seeing policy which the Clyde Trustees and the Municipal Authorities had adopted of doing everything possible to help anyone who wished to start a new industry in their district.

From the personal point of view of living in the neighbourhood of Scotstoun, which is in the county of Renfrew, there is no overcrowding, the surroundings are salubrious, the climate invigorating, and the works would be within tramway communication of all the educational and recreative advantages which the city of Glasgow affords.

Having once made up his mind to transfer the factory from London to the Clyde, the actual move was carried out with that vigour which characterizes everything Yarrow takes in hand.

Between 4,000 and 5,000 tons of material had to be transported, which included everything from the most delicate models to the heaviest machine tools. Everything was taken by rail, and when the move was in full swing, a train-load of from forty to fifty wagons left the works at Poplar every day. Machines had to be disconnected, lifted from their foundations, and carefully packed in the railway trucks so that no damage could happen during transit. The files of letters in the office, and the valuable drawings, had all to be carefully packed and loaded in covered vans,

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so that they arrived at Scotstoun in their proper order and without injury.

So as not to dislocate the work which was going on, and throw a number of men out of employment, shipbuilding was started on the Clyde within a few months of the first sod being cut on the site, and at Poplar the construction of the machinery was carried on up to the last moment. Not the least of the feats accomplished was the transfer of finished engines of 5,000 horse power each, from the old factory to the new one, without the slightest damage.

The Feu Contract of the new yard at Scotstoun was signed on February 24, 1906, and the first destroyer was launched on July 14, 1908.

The decision to make the move was a stroke of genius which was more than justified by the future success of the firm, and the move itself can be looked on as a triumph in organization.

CHAPTER XX

THE CONVALESCENT HOME

“Never lose an opportunity of doing a kindness.” This was the constant advice given to Yarrow by his father and mother, preached and practised with religious zeal in the home of his early days, where the kindness and sympathy which abounded was of that ardent character, the outcome of that true charity which is so often entirely dissociated from wealth.

Yarrow was particularly anxious that his own children, who would have both time and means at their disposal, should be associated early in life with sympathetic work for those in need of help. To initiate a routine of visiting in the poorest homes of London slums, possibly amongst those of degraded character, where dirt and disease are often prevalent, has serious drawbacks. These considerations acted as a motive for developing some carefully thought-out scheme which might not only be of advantage to those benefited, but prove an important influence in drawing out the sympathies of his family.

In the year 1894 he spent much time in planning the details of a Children’s Convalescent Home. His old friend, the architect, Mr. Barrow Emanuel, was his principal adviser in this work, and the two companions visited the best-known convalescent homes in the country. The good points of each, wherever possible, were embodied in a design, copies of which were forwarded



YARROW CONVALESCENT HOME FOR CHILDREN

to the matron of each institution visited, whose opinion and criticism were invited. Upon these being obtained, a revised design was prepared, embodying, as far as possible, the numerous suggestions, and from this the institution was built.

The idea of naming any work after himself, except perhaps the Yarrow Boiler, was always distasteful to him, but he consented, at the particular desire of numerous friends, to attach his name to the Home at Broadstairs, in the hope that his children would take a special interest and pleasure in watching over this work, in consequence of its being named after their father. The Home, which was to be as perfect as possible, and endowed to the utmost limit that was wise, was intended for the reception of the children of educated people who could not afford the full expense of a stay at the seaside, so necessary to a child recovering from illness or an operation. Yarrow's inclination was to help the children of those who were prepared to co-operate for their good ; therefore a small weekly charge was made.

The object of endowing an Institution is naturally to ensure its continuity, and to make it independent of outside help. Yarrow often said that at first sight this would appear a wise provision, and one might naturally think that an institution fully endowed and possessing every modern convenience would have few difficulties to face ; but keen observers will realize that the endowed institution labours under some peculiar disadvantages, for experience has shown, through the fate of many old trusts, that such funds have often been diverted from their original object, and have passed into the pockets of those for whom the donor never intended them, the reason being that

there was no independent supervision controlling the expenditure. On the other hand, the unendowed institution, dependent on subscribers, automatically secures a body of interested people to supervise the expenditure of the funds, and to ensure that the original objects of the institution are maintained; for it will be readily understood that the managers and officials are obliged to act vigorously to give satisfaction to the public and to secure subscriptions, as if such are not forthcoming, the institution fails and the officials lose their occupation. A good check on the expenditure is therefore found in the supervision which the subscribers are entitled to exercise.

After the Children's Home had been started, the founder, realizing the evils which are apt to be attached to an institution so largely endowed, became anxious as to its future. The question of how to ensure efficient management in years to come, how to keep the Home up to its maximum usefulness for the purpose for which it was designed, and yet to permit sufficient elasticity in the control to enable the work to move with the times, was a problem of great difficulty, but the eventual solution gave perfect satisfaction.

The Council of the Institution of Civil Engineers agreed to accept the responsibility of the trusteeship, and as the Council is composed of men whose distinguished reputation gives evidence not simply of outstanding ability, but of exceptional earnestness of character, Yarrow felt sure that the interests of the Home could be looked upon as safeguarded, humanly speaking, for all time. In 1903, therefore, the Institution of Civil Engineers became the owners of the Home.

On Founder's Day, in the year 1907, the Civil Engineers, to show their feeling for Yarrow, presented the Home with his portrait, painted by Hugh Rivière.

In expressing his appreciation of this kindness shown by so many of his professional friends, which touched him very deeply, Yarrow made the following short speech :—

“ It is not possible for me to express in words how deeply I feel the great kindness of my many friends. There is nothing in life more delightful than friendship, and this act is a most charming evidence of it. Just in the same way that a boy's companions at school often determine his character more than anything, so one's friends in after-life, more perhaps than anything else, conduce to one's happiness. Therefore I value, more than I can possibly express, the warm friendship which has brought about this pleasant incident in my life.

“ Your President, in his remarks, has complimented me about this Home in a way far in excess of anything that I can possibly deserve, but I cannot help saying that I do not see that there is any merit to one who simply does what pleases him most, and, to follow up the argument, it might be of some slight interest to those who are here, for me to explain fully what I mean, and how it came about that this institution was started.

“ When a person has been what is termed ‘ successful in life,’ and finds himself with a balance at his bankers in excess of what is necessary to meet the wise requirements of his family and himself, a great difficulty has to be faced, one which has puzzled many people—the problem being to know how to do the best with what is over.

“Firstly, he can leave the money to his family.

“Secondly, he can leave it to those who come after him to distribute.

“Thirdly, he can spend it in his lifetime.

“Now let us consider the merits of these alternatives.

“First. A father is, naturally, anxious to do what experience has indicated as best in the interests of his family, and I think the best legacies parents can leave to their children are two in number—namely a good constitution and the necessity for work. My dear father and mother left me these legacies. I am afraid I didn’t think much of them at the time, but now, at my age, I appreciate their overwhelming value. I am sure it will be freely admitted in an assembly like this, that the necessity for work is perhaps the most important asset of every young man. To leave large sums to one’s family deprives them of this important asset, and it is not the way to encourage either enthusiasm in work or to induce them to lead a useful life, but rather tends, as experience has shown, to result in a life devoted to pleasure. Although there are some brilliant exceptions to this rule, there is little doubt that wealth has a very debilitating effect upon the character of the young.

“In support of this I cannot do better than refer you to a portion of a speech made by our friend, Sir Alexander Binnie, in which he said that :—

“‘The most pronounced failures that I have seen among the younger members of my own profession during the last forty years have always been due to the fact that these young men in the early history of their lives were endowed with independence. I know of no more detrimental influence that can possibly assail young men than that they should enter life feeling that there is no necessity to work.’

“Now I think it may be considered that the leaving of sums to one’s own family, after having provided for their legitimate requirements, is unwise in their own interests.

“No. 2—that of leaving the excess to be distributed and dealt with by others after one has gone.

“From my own observations there seems to be a certain charm in holding on to what one has until the last minute. We know we cannot take it with us when it is our time to go, and from the latest information I have on the subject, we are not even allowed to take a few pence with us as pocket-money.

“It would seem hardly fair to burden other people with the onus of the wise distribution of the wealth a man leaves behind him, as it were, under compulsion. And, in addition, one cannot feel sure that the money will pass into the proper channels. It oftens happens that our legal friends get hold of a portion, as the result of some dispute, or, it may go, for example, to promote that new industry which has lately sprung up among us, and which is undoubtedly now a definite business, namely, the ‘unemployed,’ which not infrequently tends to diminish rather than encourage industry and thrift. So I think we are justified in putting aside this second alternative as one which may possibly be improved upon.

“Consequently, there remains only the third alternative—that of spending the balance in one’s lifetime. By such a course one has the great satisfaction of seeing one’s plans carried out, and also one ensures the money being spent, as far as possible, in accordance with one’s wishes; and I think it will be generally admitted that the best way of spending money is to endeavour to secure the maximum good of the

community, especially in helping those who are prepared to help themselves.

“ Dr. Barnardo, many years ago, drew my attention to the fact that there was a very large number of most respectable and very worthy people, forming an important part of the community—people who had to keep up a good appearance—who, by dint of care and economy, just managed to make their income and expenditure balance. If any calamity came, such as serious illness, it upset this balance, and handicapped them possibly for many years to come. It was, therefore, deemed a very wise distribution of the funds at my disposal to help families under such circumstances, and there is an exceptional pleasure in helping children, because, in the first place, they can’t deceive you, and in the second, we must remember that the children of to-day are the parents of to-morrow, and to strengthen their constitutions and promote their health undoubtedly is a national benefit.

“ When I look back upon the twelve years’ working of this Home, I have every reason to be satisfied with what has been done.

“ I am quite sure that everybody in this room can understand the pleasure which this institution has brought into my life in enabling me to give a helping hand to this large family of 100 children, and I feel that the pleasure it has afforded me is infinitely greater than any pleasure that I could have derived by keeping the money. Therefore, I think, on the whole, I have conclusively shown that, as I am a gainer, there is no credit whatever due to me, which is what I set out to prove.

“ Incidentally, this Home has brought further pleasure to me which I greatly value ; it has thrown me

more in contact with those friends whose companionship I so much enjoy, and these friendships have added more than I can say to the charm of life.

“Now for the picture. I believe it is considered a very fine likeness, but I do not like to express any opinion upon it, because I believe if an artist depicts on canvas a person better-looking than he really is, he always considers it an exceedingly good portrait.

“In an assembly of engineers like this, perhaps some statistics might be interesting, such as we find in Molesworth’s ‘Pocket-Book’ (which is as dear to every engineer as his 2-foot rule). I am sixty-four to sixty-five years of age, and I don’t believe I have ever remained standing still at one time for five minutes in my life, until quite lately ; but Mr. Rivière actually demanded that I should remain in a vertical position for no less than 1,080 minutes. I mention this fact to show you the magnitude of the enterprise of having your portrait painted.

“Now, ladies and gentlemen, I have nothing more to say, except to repeat how very deeply I feel the great kindness you have done me. The picture is a valuable present to the Home which is so dear to me, and the album, with so many signatures, I shall always retain to the end of my days with feelings of the greatest delight, for it is evidence of that warm personal friendship, even affection, which I deeply prize and without which life is not worth living.”

CHAPTER XXI

THE EXPERIMENTAL TANK

At one time in the speed trials of vessels great depth of water was considered of paramount importance in obtaining high speed, and therefore Yarrow determined to find a measured mile of greater depth than the Maplins at the mouth of the Thames.

The firm put up mile-posts at St. Margaret Bay, near Dover, which were made use of for some trials ; but as speeds advanced, the depth available even there was not found sufficient. Posts were then erected on the Goodwin Sands, to demonstrate the feasibility of using this spot for trials, but the scheme was ultimately abandoned.

It had been found during the trials of torpedo-boats that the speeds varied in an unaccountable and mysterious manner. The effect of depth of water upon speed had been studied by several foreign experts in Denmark, Italy, and Germany ; but as investigations had been made either with models or under conditions which did not carry conviction, the results were looked upon as of doubtful value. These experiments, coupled with the apparent discrepancies which Yarrow found in speed trials, led him to take up the subject, and he organized some very exhaustive experiments with a fast destroyer. The tests were made with the same vessel, the same crew, the same displacement, on the same day, at various speeds, and at different depths



EXPERIMENTAL TANK AT THE NATIONAL PHYSICAL LABORATORY AT BUSHEY



THE NEW OUT-PATIENTS' DEPARTMENT AT THE LONDON HOSPITAL.

of water, so that, as far as possible, varying conditions which lead to inaccuracies were guarded against.

These trials at various speeds and at different depths of water led to results of exceptional practical value.

It was found that the longitudinal inclination of a vessel, with a given number of revolutions of the engine, depended upon the depth of water under the hull when running at speeds of 20 knots and over. Thus the captain on the bridge could ascertain at any moment, without stopping to take soundings, when he might be running in shallow water involving the risk of getting aground.

Simultaneously Yarrow had corresponding trials made with models, but these had to be carried out by foreign investigators. It was an actual fact, although it seems incredible that, whilst many experimental tanks existed for shipbuilders to carry out investigations on the resistance of models in foreign countries, yet in Great Britain, the chief shipbuilding centre of the world, no such tank was available for the shipbuilding industry.

Yarrow's trials, therefore, were made in one of the experimental tanks in Germany, and they confirmed the results obtained by the destroyer on her trials at the mouth of the Thames.

These experiments with vessel and model may be looked upon as forming the most exhaustive and reliable data on this subject, and they carried conviction. It was shortly after the results were made public that the British authorities refused to recognize the Admiralty measured mile at the mouth of the Thames as a suitable course for high-speed trials to be made, because after the Yarrow experiments it was realized

that speeds could be obtained in exceptionally shallow water in excess of the true speeds obtainable in deep water.

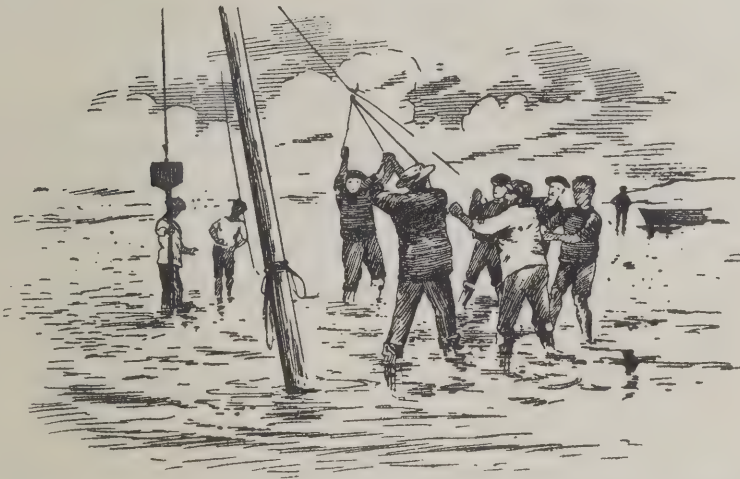
The necessity for going to foreign countries in order to investigate the resistance of vessels by experiments with models, on the lines initiated by Mr. Froude, so much impressed Yarrow that he determined to make an effort to obtain for this country an experimental tank which might be available for research work, and also for any investigations which private shipbuilders might desire.

Several efforts were made from time to time by members of the Institution of Naval Architects, especially Sir William White, to carry out what Yarrow proposed, but the shipbuilders and shipowners in this country did not sufficiently co-operate, probably through want of appreciation of the value of the scientific results to be obtained, and the necessary sum to establish a tank was not forthcoming. To ask the British Government to help was hopeless, because our politicians have never been sympathetic towards science, as in Germany and the United States. Yarrow, however, was determined that we should not fall so lamentably behind foreign countries in the facilities for research in a science all-important to our safety and prosperity, and he ultimately offered the Royal Society to provide a tank, the cost of which was estimated at £20,000, provided a similar amount, sufficient to cover the working expenses for ten years, was guaranteed. It was considered that the annual upkeep and maintenance would amount to about £2,000, and that after ten years the tank would prove its value, and would never be closed.

Yarrow's offer was accepted, and the National

Physical Laboratory at Teddington was chosen as a suitable place for such a tank.

The formal opening took place on July 5, 1911, during the Jubilee Meetings of the Institution of Naval Architects in London. Under the control of a highly scientific body of men, research work is carried out, and experiments of a confidential character are made with accuracy, and with a certainty that the results are not divulged.



PUTTING UP MILE-POSTS FOR SPEED TRIALS ON THE GOODWINS.

(Photograph taken on the Goodwins.)

CHAPTER XXII

MISCELLANEOUS PUBLIC WORK

Amongst the most efficient and thoroughly up to date of institutions, criticized by every branch of the great public upon whose generosity to the extent of £250,000 a year its existence depends, is the enormous London Hospital—almost a little colony in itself, containing nearly 1,000 beds.

Yarrow's interest in this institution dated, like that of many of its supporters, from his first meeting with Lord Knutsford, then the Hon. Sydney Holland. This occurred at the annual dinner in connection with the Poplar Hospital. Mr. Arnold Hill, a strict vegetarian, was to have taken the chair, but as he did not arrive, Mr. Holland, President of both the London and Poplar Hospitals, took his place, and proposed to the guests assembled that they should commence dinner. A telegram was received conveying Mr. Hill's regret at his absence, the cause being that his big Newfoundland dog had bitten the laundrymaid's leg. Mr. Holland, with his usual ready wit, pointed out, on reading the telegram to his guests, that Mr. Hill, being a strict vegetarian, was not so much upset on account of the laundrymaid's misfortune, as because the dog, brought up on vegetarian principles, had for the first time tasted animal food !

Yarrow, with Mr. Holland, visited the out-patients' department of the London Hospital, which at that time

was a very insanitary place, where there was neither space for decent privacy, nor air for waiting crowds to breathe. The doctors' consulting-rooms were damp and unventilated, and it has been said that almost as many illnesses were contracted as were cured.

The chairman declared himself in despair—he had no funds, and was powerless to improve matters. The result of this visit was far-reaching.

Yarrow promised £25,000 towards an entirely new out-patients' department on the following conditions, which were, he always declares, of more value than the gift :—

(1) A sufficient sum must be raised to build and equip a new out-patients' department of the most perfect kind, and, as £75,000 was estimated as the probable cost, £50,000 more must be assured.

(2) Letters of admission from subscribers, over which great abuses had crept in (for example, they were sometimes parted with in exchange for drink), were to be abandoned.

(3) Every out-patient (children excepted) should pay some small amount towards the expenses of the medicine or bandages supplied; treatment or advice to be free.

An objection brought forward to this last condition was that the people were all so poor that they could not possibly afford even a small sum. Mr. Barrow Emanuel offered to help in the matter, and undertook to interview, during one day, every one entering the out-patients' department. The conversations which took place were more or less as follows :—

“Do you appreciate the help you get from this Hospital?”

“Yes, I do.”

"Do you ever give anything towards its support?"

"No, I don't."

"Why not?"

"I have never been asked."

"Would you give a trifle if you were asked?"

"Yes, I would."

"How much could you afford?"

The answers varied from one penny to two or three shillings.

These replies were carefully tabulated, and it was found that nine out of every ten patients would readily give something in return for treatment.

Yarrow's gift was accepted, and led to the regulation being established that every patient should pay the sum of 3*d.* for medicine and bandages. As the result of these small payments a sum was annually raised equal to the interest on £80,000. Yarrow had every reason to be satisfied at the outcome of this condition in connection with his gift.

He has always contended that it is thoroughly wrong to give advice for nothing when patients are willing to pay something, for not only does the Hospital lose these amounts, which would help to extend its usefulness, but such practice actually tends to pauperize the patient, instead of encouraging thrift and self-respect. When, therefore, any hospital complains that certain wards are about to be closed for want of funds to pay their working expenses, and yet patients are not asked to help the institution by a small payment which they would willingly make, he does not sympathize with the need caused by this unwise policy.

The amount required for the new out-patients' department was raised, and on June 11, 1903, our late King Edward opened the new buildings.

Yarrow watched the development of the London Hospital with constant interest, and once more his name was connected with its work, for in 1908 a gift of £20,000 was made by him to found a research fund. The aim of this fund was to provide an income for those possessing talent and willing to devote their lives to medical research. Much valuable progress is lost because the medical man who is specially fitted to carry out scientific investigation is often without the means whereby to live and support his family, and therefore he cannot devote his time to research work, which, invaluable though it be to the future of humanity, does not at present yield a livelihood to the scientist.

When the firm went North, Yarrow determined to take part in some scheme which might benefit the Scottish people.

To provide nurses for sickness or at childbirth, in distant and sparsely inhabited districts of the North of Scotland, should appeal to every one. The system of nursing which meets this need, and which can be carried out at the minimum expense, is known as "cottage nursing." Such nurses must not find it impossible to live in the cottages of the poor, for they must be willing to take charge of, and manage the home during the confinement of the mother. They should have a thorough training in maternity work, as well as a fair knowledge in the treatment of ordinary complaints. An important part of their work is to show the necessity for cleanliness and good management, also to teach the mother how best to feed her children. Many homes have been reorganized through the example and teaching of nurses of this type.

The nurses live in the cottages during the time of confinement and convalescence. They differ in this way from those who have had long hospital training, and who would consider it outside their work, except in emergency, to light a fire, to scrub a floor, or to prepare the husband's meals during the time of the wife's incapacity to carry out these duties. It must be borne in mind that two or three cottage nurses can be trained for the same expenditure as one of a longer hospital experience, and thus, for a given sum, a greater number can be sent where they are so urgently needed.

Yarrow's interest in this system of nursing was shown by a gift of £24,000, used partly in adding to the Nurses' Training Home at Govan, and partly in grants for establishing such nurses in the isolated Highlands and Islands of Scotland.

This scheme of nursing is due to the Duchess of Montrose, and its successful management is still in her hands. It is perhaps not generally known how much patient, untiring work has been carried out on these lines by the Duchess and her daughter, Lady Helen Graham, beloved by the nurses as well as by the sick poor who are frequently visited by them.

Another work of far-reaching influence, although at first sight and in comparison with other institutions a very simple and unpretentious scheme, was a small Girls' School for Domestic Service at Roselawn, Chislehurst, with a cottage attached. The house, cottage, and a most liberal endowment for the work were given to the writer of this book, who originated the scheme, and managed it on her own lines.

The pupils had to be recommended as of good char-

acter, for the school was not intended to reform difficult natures. The girls, after a short training, were placed in situations as domestic servants, their careers were closely watched, and in most cases more assistance and encouragement was given to a girl after she had started in her situation than during her stay at the school. About thirty girls went out to service during each year, the training averaging about four months. The Institution was ultimately handed over to the Foundling Hospital after 400 girls had gone out to work from the school.

In all philanthropic affairs the lines to which Yarrow has adhered have been clearly defined. He prefers to assist those who have within them the elements of success; e.g. to help the constitutionally sound to recover from illness or accident; to give a bright boy a good education; to assist those who are enterprising and have capacity. It is impossible to finance everybody who needs such assistance, and Yarrow always said he would rather help to make a success than to mitigate the sadness of failure.

Although he appreciated the excellence of the almshouse for the aged, the hospital for the incurable, the private lunatic asylum, the home for the inebriate, the reformatory for the vicious, or, in another category, the society for lost cats and dogs, he preferred to leave the support of these institutions to those whose sympathy turns naturally in such directions.

Yarrow often quotes his late friend Canon Barnett's remark: "It is difficult to make money honestly, but far more difficult to spend it wisely."

CHAPTER XXIII

VIEWS ON EDUCATION AND EMIGRATION

Yarrow has constantly urged upon the head masters of public schools the necessity for modernizing their methods. The course of study, he maintained, should be so arranged that on leaving school and entering a technical college, a continuity of training may be obtained by young men. To effect this it is necessary that one section of the school should be adapted to work in harmony with scientific colleges, for it is often found that students on leaving school are so badly informed in the rudiments of science that a great deal of the first year is spent in elementary training which should have been acquired during school life.

There can be no doubt that great gain, from an educational point of view, would be derived by the professors of the colleges coming into conference with teachers in schools, so as to arrange this continuity of study.

In the public schools of this country the head masters are generally men selected on account of the distinction they have gained in Classics at the two leading Universities; and although for some paths in life Yarrow realized the necessity for Classics, yet there are other careers for which he maintained it could hardly be considered essential to study the works

of the ancient Greeks and Romans, who, for instance, were not authorities on modern science. He arrived at the conclusion that an altogether overwhelming importance is attached in this country to the study of Classics, much more than is necessary to meet the requirements of the majority of the population, and that a schoolboy, desiring to enter a scientific profession, is not making the best use of his time in following the usual curriculum prevailing in public schools. Moreover, in these schools, far more enthusiastic encouragement is usually given by the head master to his classical students than to those who aim at a scientific training. Thus it often happens that the modern or scientific side of a school is looked upon as of secondary importance. If a fair proportion of the head masters of our public schools were drawn from men who have distinguished themselves by their scientific attainments, it is possible that many boys would find themselves better prepared for the various professions open to them.

Educational matters have always been the battleground of conflicting opinions, and the training of engineers is no exception to this rule. In order to ascertain how young men were being educated in those countries where this profession was making the most rapid strides, Yarrow asked a distinguished professor to visit the United States, Berlin, and Zürich, in order to study the respective methods of education. On his return the professor gave the result of his investigations in two lectures. These led to a vigorous discussion, in which many eminent men took part.

It may be taken for granted that both theory and practice are essential to the engineer, and Yarrow

continually urged the advantage to lads of working in the shops for practical training during the summer, and attending colleges for the study of theory through the winter. This procedure was known as the "Sandwich" system. It had been more or less the custom for years in Scotland, and had proved a success. The idea originated in olden times, when men worked on farms in the country districts during the summer, and saved sufficient money to go into the cities for study during the winter. The scheme never found much favour in England, partly because the Universities divided their year into terms which did not fit in with this arrangement, and partly because many firms were unwilling to admit young men into their works for short periods.

Yarrow showed his willingness to co-operate in any system of this kind by receiving into his works a limited number of young men during the summer vacation, and students from the Universities had frequently availed themselves of this privilege. He contended that, whatever the difficulties might be in the application of the "Sandwich" system, if it were possible to obtain generally a six months' session at College, alternating with six months in the workshops under working conditions, a combination would be arrived at which would be beneficial both to the colleges and to the students.

On being asked what he considered the prevailing fault among young men whom he desired to advance, Yarrow has often said:—

" 'Side' is the one great evil to be feared. Young men, highly educated, and of good social standing, when placed in responsible positions, often become overbearing and thus arouse ill-feeling among those

with whom they are associated and upon whose co-operation their success greatly depends.

“The possession of power is what everybody naturally and properly aims at, but it is the conspicuous grasping of power and the unnecessary exhibition of it which are objectionable—and have ruined the careers of many who would have been successful had it not been for this serious defect in character.”

“Many a time,” said Yarrow, “I have given a man a good bonus, and the next time he came into my office he kept his hat on and gave himself some particular air which had never before been apparent. On such occasions I have more than once remarked: ‘As you keep your hat on, you might go and fetch mine.’ ”

Apart from the above considerations there is no doubt that the British Public School system is unequalled as a school for character, and Yarrow has often said that the ideal education to meet the requirements of the majority of the population (though not all) is one which combines the character-training of a Public School with the intelligent teaching of science.

Many young men have come to this veteran for advice as to the best means of obtaining success. In late years the prospects of engineering in this country have not been as bright as formerly. The railways and bridges are built. Foreign competition and other causes have stopped the development of some of our existing factories; and for an enterprising engineer of talent the best plan, Yarrow now declares, is to go abroad, and be willing to lend a hand at first to anything.

As he was often asked by young men what part of

the world he would recommend for successful emigration, he gave a good deal of consideration to the matter during his travels abroad, in order to be in a position to give the best advice he could to the rising generation.

In the first place, it depends upon temperament, tastes and capabilities. For those who like an open-air life—farming, riding, physical exercise—he would suggest Canada or Argentina, and not a position in a commercial house in a large city. On the other hand, it is obvious that a man suitable to fill the position of a clerk or to become a banker would not be much use on a ranch.

There are too many men with black coats, and they should not go abroad without, if possible, having a definite position in view. Many people attach far too much importance to a black coat, as they imagine it raises their social position. The educated man with good manners, who can and is willing to turn his hand to anything, and who has a knowledge of some trade, has the best chance of getting on. There is an opening for him in almost every part of the world. Many of the black-coated people would fail anywhere, as they are so often not ready to tackle any and every job, and possess an imaginary dignity which is altogether out of place. The opportunities offered to earnest men, willing to work hard—as every man must work who wants to succeed—are very great in new countries; but many go abroad believing they are going to find an El Dorado where there is much money, and little to do in order to acquire it.

As a rule it is wise, if possible, to be associated with a rising firm, in a rising industry, in a rising country.

A young man should endeavour to obtain introductions to one or two suitable families in the place where he intends to settle, as that will often enable him to get over the difficult period when he first makes his residence in new surroundings. It gives him an opportunity of spending some of his evenings with nice people, and thus avoids his being led to undesirable places of amusement. Failing such introductions, or even in addition to them, it is a safeguard for a young man to know some one who has lived in the country for some time, and who could give him both warning and advice.

For leisure hours the cultivation of music and of sports is excellent, and such recreations often lead to pleasant companionship. As soon as a young man has had time to look round, he should join the best Sports Club (cricket, tennis, football, boating, etc.). If he has had the advantage of a good public school education, he will have no difficulty in becoming a member.

It is needless to say that every young man must refrain from drinking spirits and cocktails. It may seem at first difficult to refuse, and appear unsociable, but even those who drink spirits themselves know the evil effects, and invariably admire those who have enough strength of will to avoid beginning the habit. He who laughs loudest when a young man refuses stimulants will, in all probability, be the first to think of this abstainer when there is an important position to be filled.

Any lad who goes abroad should have a strong character, capable of resisting temptation. This is especially necessary in hot climates. At all costs he must not fall to the temptation of women, or his

fate both morally and physically will probably be sealed.

Before going to settle in a foreign country (such as one of the South American Republics, some of which are undoubtedly rapidly advancing) it is essential to acquire a knowledge of the language.

If a boy wants to take up agriculture he should, without however specializing too closely, learn all he can about the scientific methods applicable to his particular branch—the growing of grain, coffee, tea, sugar, or whatever it may be. Should he wish to go in for mining, a knowledge of geology is necessary.

Anyone seeking his fortune abroad should have sufficient money to enable him to live for at least six months, so that he is not obliged to take the first job he can get in order to maintain himself. If his means are limited, he should either not marry, or else, if he does, should determine not to have a family until the future looks reasonably secure.

Before hastily sinking capital in any foreign business, he would be wise to seek employment at a salary for one or two years so as to get accustomed to new surroundings, to learn the work, and to judge where capital could be made use of to the best advantage.

In any country good health is all-important, and until the new-comer gets acclimatized his food should be as nearly as possible the same as he is accustomed to at home. Unpeeled fruit, or food upon which flies have had opportunities to settle, should be avoided. The water should at all costs be boiled until it is beyond question safe to drink. It is well to dress suitably, and always to bear in mind that any impru-

dence, such as sitting in a draught when heated, is likely to have more serious and rapid results in a tropical climate than at home.

One of the most valuable assets for an industrious young man is good manners. Needless to say, the idle can never succeed in any country.

CHAPTER XXIV

VIEWS ON TACT, WEALTH, AND THE HIGHER EDUCATION OF WOMEN

(Jotted down from Yarrow's conversation.)

It has been said : " If you need money, you can work for it ; if you want grace, you may pray for it ; but if you are without tact, there is no hope for you."

" How can my son acquire tact, or, to express it in other words, business aptitude ? " asked a professor. " I thought of putting him into an accountant's office for a year. Do you think he will learn tact this way ? "

" He may obtain a knowledge of book-keeping," was the reply, " but not tact. The two things have no connection whatever ; many men who have been all their lives in an office, are utterly deficient in tact."

The best way to acquire special knowledge is for the student to associate with experts in the subject which he wishes to study. Thus, to acquire tact let him seek the society of those who possess it, and observe them closely, because they will unconsciously display this quality without intermission in daily life. Although to some extent innate, it is also contagious, and fortunate indeed is the young person having the example of parents who demonstrate in their daily conduct the worth of this possession.

In every full life abundant opportunity presents itself almost hourly for the exercise of this quality in dealing with relations, friends, clients, and servants. Tact embodies self-control, foresight, imagination, sympathy, and that understanding of human nature which makes a person capable of grasping another's point of view. Therefore, it must not be looked upon merely as a superficial grace, which may, or may not, be inherited ; neither must it be considered an artificial accomplishment, but one of the mainsprings of a smoothly running, happy and successful life.

A man possessing tact has the power, to some extent, of foreseeing the future, in the same manner that a good chess-player foresees the probable moves of his adversary and the result of certain moves of his own. Prior to an important interview, such a man will consider his policy, the probable questions which may be put to him, and the answers to be given in reply. He will carefully study what he is going to say, and may even make notes upon his subject, so that he will never go unprepared into the presence of a distinguished person to discuss important affairs.

The man who possesses tact to its fullest extent is one who, having a knowledge of human nature and a capacity for sympathizing with others, carefully avoids doing or saying anything which may hurt the feelings of another. Such wounds never lead to any good, and to be careless of other people's feelings shows unfitness to occupy a leading position. It is quite possible to tell another of a fault in such a manner as to make him a friend, and also to do a kindness in such a way as to arouse his resentment.

We have to realize that what we say or do is under

our own control, although what we feel, or what we think, may not be. A man whose feelings are wounded may know that he ought not to feel hurt, he may be fully convinced that an unkindness was never intended, and yet, in spite of all this, and against all common sense and reason, the wounded feeling remains, and pleasant co-operation is disturbed. Yarrow used to say : if a man cuts off your head, whether he meant to do it or not, it is the same to you.

It is often said to an over-sensitive nature : " You ought not to feel offended by what was said, and it is necessary to become hardened to such things to get on in life." But this may be asking too much. The real fault rests, not with the man whose feelings are hurt, but with the one who hurt them, because he was either lacking in self-control or ignorant of human nature.

Above all, to reprove another before a third person shows want of good feeling. The fact should be appreciated that young people especially require encouragement, and often a word of praise will do much to make a member of one's staff happy and contented. If one has a complaint to make, it is wise to associate it with a word of encouragement in connection with some other part of the work deserving credit.

It is needless to say that a man with an uncontrolled temper, or one who is frequently irritable, is incapable of exercising this important quality.

It is worthy of note that the leaders of the most important affairs, and those who have got on by their own ability, are usually men who have developed tact to a great extent. To live in frequent intercourse with one who holds these principles and acts upon

them in daily life, is, to an observant philosophic nature, to have a constant lesson in the highest form of tact.

The trials of the poor are constantly before us, and are very real. We hear of them in every church and from every charitable institution; yet true philosophers must realize that absence of wealth provides magnificent discipline, encourages earnestness of purpose, steady and strenuous work, simplicity, and that true understanding of life which leads to sympathy with the needs of others.

The trials of the rich are not often mentioned. They exist, however, and are not confined to the wear and tear of dealing with appeals for charitable objects, although, should a rich man personally peruse even a small part of his correspondence describing the woes of others, and pointing out his powers to mitigate their condition, he might well lead a melancholy existence.

The rich man is often unconsciously debarred from intimacy with many people of culture and refinement. The intellectual worker, the scientific or literary person who has perhaps not attained recognition, or is not in receipt of a comfortable income, is somewhat diffident in seeking the companionship of the man of wealth. The fear that his desire for friendship with the successful or wealthy man may be misunderstood, and that under the guise of affection the ignoble seeking of benefits may be suspected, often raises a subtle barrier to free personal intercourse between the rich and the poor. Thus a rich man may be easily separated from those whose friendship he would greatly desire, and he may be surrounded by a circle of people from whom he would gladly escape, by whom a man

without wealth or position is, to his own advantage, studiously neglected.

It must have been noticed that absence of wealth and the consequent necessity for work teach many lessons to the young, and draw out many virtues hardly produced by any other means. It is scarcely possible to create artificially these conditions to such an extent that they will serve as a training for the children of the rich. It is the overcoming of difficulties which forms character; the necessity for work, which leads to industry. And could the wealthy parent add these essentials to certain undeniable advantages secured by riches, he would not have to deplore so frequently spendthrift sons, daughters without earnestness of purpose, and the complete absence in his children of energy and enthusiasm in useful and intellectual pursuits.

In the upbringing of a family, the wealthy parent is surrounded by snares, more insidious because they are unrecognized, except by the philosopher, or by those who realize too late that their children have been enervated by their surroundings. The child of luxury, who has the best food procurable, who is watched over night and day with unceasing care, taught by the most expensive professors, given change and amusement whenever it appears desirable, this child surely should have the best opportunities for satisfactory development. The thoughtful, however, will perceive that the carefully nourished and charmingly dressed child is frequently brought up from its earliest years to be dependent upon others instead of being self-reliant. He has certain respectful attentions showered upon him, which he has done nothing to merit, and the idea which unconsciously takes posses-

sion of him is that much, if not all, that surrounds him, is his by right ; thus an enervating atmosphere is created, the influence of which it is extremely difficult to counteract.

Although the pitfalls due to wealth in the training of the young lead, in many instances, to disastrous results, there are brilliant exceptions to this rule. We all admire the self-made man who, through his energy and ability, gains distinction ; but to add reputation to an inherited position, by good work, industry, or scientific attainments, without the incentive of poverty and the desire to acquire that to which a man is not born, is even more worthy of admiration.

At one time, eager parents came down to Poplar in a continuous stream with their sons, desiring that they should become engineers. Yarrow has given some amusing descriptions of the interviews which he had with such parents. He maintained that a boy who possessed any real taste for engineering would have shown it by the time he was sixteen by having constructed some piece of work. The mothers, feeling generally confident that their sons possessed hidden genius, often appeared vexed when asked what evidence there was that a lad had any gift for mechanical work.

Drawings were frequently shown, which the lad had done at school, but this was not considered evidence of talent, and it was pointed out that although a boy might write an excellent hand, it did not follow that he would acquire literary fame.

It frequently surprised Yarrow on what little evidence parents would build up hopes of budding genius in their sons. One lady visited Poplar with a sleepy-

looking boy who, his mother felt sure, would rise to eminence. She told Yarrow that, with regard to her second son, there was no question as to what his profession should be, viz. a dentist ; and when Yarrow asked her on what ground she had come to this conclusion, she replied that he was always “ pulling nails out of boxes ! ”

On another occasion, an important-looking gentleman arrived, bringing with him his son and a letter of introduction from a person of eminence. He opened the conversation by saying that he wished his son, who was to be an engineer, to serve his time in the works at Poplar. Yarrow turned to the lad, and told him that to enter the works he would have to pass an examination, and that he would have to be at the yard at six o'clock in the morning. The father interrupted at this point, saying that this would not be possible, for he wished his son to live at Kensington, which was 15 miles away. Yarrow showed some surprise. The father then observed : “ You understand money is no object,” to which Yarrow replied that he felt sure their works would not suit the lad, and the visitors departed, thinking him the most disagreeable man they had ever met, while he on his part deplored the folly of a rich father who offered his son every inducement to be idle.

As the result of keen observation and association with people of every position, “ there is little doubt,” Yarrow declares, “ that the highest average of happiness is found in those homes in which people are free from financial anxiety, yet obliged to work, and unable to surround themselves with luxury. Assume there are a hundred families, each father possessing an income of £10,000 a year, and another group where

the fathers have an income of £1,000 a year; there can be little doubt which group of families, on the average, would develop into the best citizens, and become the most useful members of society."

"In motoring," Yarrow used to say, "always ask a girl the way. They are much sharper than boys." This conviction led him to favour every scheme for giving women power and influence in life, and for enabling them to enter upon careers for which they show intellectual or other gifts necessary to carry out the work efficiently. He delights in hearing women speak in public, declaring they bring into their subject more sympathy than men, and for this reason they are particularly suited for platform speaking, if that duty devolves upon them in their chosen work, and does not take them away from the prior claims of family life.

Women, old and young, have always found a champion in him. It may be that this enthusiasm for, and confidence in, the ability of the opposite sex became deeply rooted in his early years through his love and admiration for his mother, to whom he confided every event in his life, whether connected with business or private affairs, whose sympathy never failed him, and whose shrewd advice proved to him an unfailing guide.

On committees he always welcomes the presence of women, for he says, "The woman's view is not necessarily better or worse than a man's, but it is taken from a different standpoint. A man's view alone bears the same relation to that taken by a man and woman together, as a photograph taken from a fixed spot does to a stereoscopic picture."

"Never arrive at an important determination with-

out first consulting your wife," said Yarrow to his son at the time of his marriage. "Ask your wife's opinion upon everything of moment. You need not always take it," he added.

If a girl desires to take up a university course, not only does she gain knowledge in any line which appeals to her, but her work keeps her from drifting into a fashionable and aimless life. It is, perhaps, undesirable to put pressure on a girl to go to a university, but if she inclines in that direction, surely it is wise to encourage her; and if she should continue her studies, three years of the most important and impressionable portion of her life would be passed safely over. It is often said by the ignorant that a university training unfits a girl for domestic life, but surely no thoughtful person can consider that ignorance is a necessary requirement for bringing up a young family.

Having met many university students, and made careful inquiries as to the result of such training, Yarrow, after a visit to Girton College, Cambridge, decided that the debt at the time, £24,000, which was naturally a burden upon the college, must be paid off. He therefore arranged, anonymously, that if £12,000 could be collected within three months he would give the remaining £12,000. To his satisfaction this sum was subscribed, and in January, 1914, Girton started the year not only free from debt, but able to found two fellowships.

In 1920 he gave a further £10,000 to Girton to aid students in carrying out scientific research work. This scholarship was given on unusual conditions. As a rule, only the interest on the sum invested is to be used, and a balance at the bank will be found when the world

comes to an end. Yarrow stipulated that the capital as well as the interest should be spent, and such annual sums should be drawn from the capital that it would be exhausted in twenty years. In practice it comes to this : that £800 a year is available for twenty years instead of £500 a year in perpetuity.



CHAPTER XXV

A FEW WORDS ON POLITICAL ECONOMY

The workman who turns up a shaft, or who does riveting, performs work which has a definite value, and this value determines what he shall be paid. In other words, his salary should not be in any respect dependent upon the success or failure of the firm, any more than would be the case with the merchant who supplied the steel or wood, which is paid for at the market price at the time, the price having no reference whatever to whether the ship constructed with the steel, or the house built with the wood, has resulted in a profit. One would not, if a contract proved exceptionally successful, go to the iron merchant who supplied the steel and say to him, "My good man, I will give you £1 a ton extra for the steel you supplied because the contract in which it was used has been very profitable." Nor, on the other hand, would the man who supplied the steel think it reasonable to be asked to charge less than the market price if the contract upon which it was used turned out unprofitable. A man ought to be paid according to what he does. If A does twice as much work as B, he ought to receive at least double the amount of B's wages; in fact, he ought to be paid more than double, because for a certain quantity of work done the establishment charges would be proportionately less.

These are the reasons why Yarrow always contended

that to form a profit-sharing scheme among the work-people of a firm is, in principle, wrong, although in some cases it can be adopted with advantage.

The prosperity of the firm cannot be considered to be dependent upon this section of the employés, and therefore their remuneration should be quite independent of the success or non-success of the business in which they are engaged. Moreover, it would not be just for them to share in the profits of the firm, considering that it would be out of their power to share in the risks and losses. Of course, any man who is exceptionally skilled is entitled to be paid at a higher rate than one who is less skilled ; and let it be granted, though with a certain amount of reserve, that a man who has secured the confidence of a firm through long service, although he may only do work which has a definite value, may not unreasonably expect extra remuneration, owing to the special trust placed in him.

Now we come to another class of employé, of whom there is generally a small group in every industrial enterprise—those who have a very far-reaching effect upon the prosperity of the firm, and whose services are not of a fixed value. This small group consists of the members of the staff who have “special knowledge,” and who are in many cases of more value to their particular firm than they could be to any other. Such members of the staff should be remunerated on an entirely different basis from the mechanic. Those who have added materially to the success of a firm should undoubtedly share in its prosperity. If the head of the firm is just, and assesses at its proper worth the service rendered, probably no better arrangement can be devised than for each member of the staff, in

addition to a fixed salary, to be from time to time proportionately remunerated when the firm is prosperous. This method of dealing with one's staff facilitates the carrying on, in bad times, without serious loss, of a continually fluctuating business.

Those are the general principles which governed Yarrow in his financial dealings with those in his employ.

It has sometimes surprised people to hear the head of an industry say that sentiment should be brought into the relations which exist between the head of a firm and his staff, and that these relations should not be based solely upon the hard and fast lines usually found in business dealings. There should be an enthusiasm and a feeling of loyalty towards the firm, something like that which a boy feels towards his old school, to ensure the right spirit in the works. If once this feeling can be developed, the daily duties of life become a constant pleasure, instead of a tax.

One reason why Yarrow, in spite of many advantageous offers, has never been induced to develop his works into a big limited liability company is that the personal feeling between himself and those with whom he is intimately associated would gradually disappear, and, in addition, the special work done by individuals to promote success in the past would never be considered by a board of directors, who would, in all probability, know nothing of the early history of the firm.

Yarrow's administration and his relations with his staff have been described by visitors, both British and foreign, as unique, almost patriarchal. In fact, the union between Yarrow and his staff can be best

expressed by saying there exists nothing less than mutual feelings of affection. This was proved by the length of time they were associated together. Before the move from Poplar to Glasgow, twelve members of the staff dined with Yarrow, and it was remarked at the time that the average period of service of those present amounted to twenty-five years.

All the leading members of the firm, during many years, met Yarrow every day at luncheon. When this custom was initiated, it was explained that there would be no whisky, wine or beer provided, but if any gentleman felt the need of something stronger than lemonade or coffee, he need not feel bound to accept the invitation of his chief. Example counts for a good deal. The habits of the leading people are quickly known, and there is little doubt that this abstemious custom had a far-reaching influence throughout the works.

The gathering of this little party led to other important results, for many discussions over design and construction took place, and many problems of policy and organization were solved over cups of coffee. Some inspectors, new to the firm, arrived full of distrust, but when they became acquainted with Yarrow, his son, and his staff at the sociable luncheon-table, friendship in many cases replaced suspicion.

The following small incident perhaps illustrates better than any statement could do what exceptional terms Yarrow was on with those around him.

One of the trusted old employés in the office was having a chat over various abuses (recently brought to light) which had crept into the firm, leading to waste of time and money. Yarrow said: "I do wish you would all tell me of these things when they are going

wrong, and not leave me to find the matter out when it has become an established evil. Now," he added, "if you see anything which could be improved, or anything unwise, either in what I do, or in any department, just tell me at once." "Well, sir," replied A, "I should hardly like to do that." "I can assure you," said Yarrow, "I should be most grateful." "Well then, I do think, sir," said A, "matters would get on more quickly, and less time would be lost, if you came down to us in the office, and did not remain up in the luncheon-room so long." Yarrow laughed heartily.

Three months afterwards, when some bonuses were to be distributed, A was sent for in his turn. After a little complimentary chat, Yarrow said: "I was going to give you a bonus of £80, but as you told me I sat chatting after lunch too long—I made it £100." A was greatly astonished, for, as there was a slight pause when this remark was half through, he expected, he afterwards declared, to hear the cheque had been reduced from £80 to £60 on account of his criticism, which had been made absolutely on the spur of the moment.

Although reputation is beyond price, the saving of cost is essential to a successful business. To effect this, it is imperative that the drawing-office staff should work in sympathetic conjunction with those in the workshops. In some factories the technical genius in the drawing-office never seeks the advice of the practical man who has to carry out his designs. There was nothing, Yarrow often said, which would raise a draughtsman more in his estimation than to find him asking advice from those who had to construct and work the machinery he designed. The



A. GROVES R. D. KEAY
W. N. STONE W. W. MARINER

S. T. CRUSH C. COTTON
J. MCQUEEN H. W. DUDIN A. W. NESBITT H. E. YARROW
W. CRUSH A. F. YARROW

YARROW STAFF AT THE TIME OF THE REMOVAL FROM LONDON TO GLASGOW

drawing-office, on the one hand, should not take offence at the criticism of those in the works; and, on the other, the practical man should make his observations in the most courteous manner, so as to avoid offending the susceptibilities of those who have done their best to make the design as perfect as possible, and which he himself could not do as well.

“It must be remembered,” Yarrow told his practical men, “that a draughtsman may be compared to an author, upon whose book it is legitimate for every reader, whether he can write or not, to pass judgment.”

The War Section Written as a Supplement Ten Years later and Added to this Book in 1922

CHAPTER XXVI

WAR SERVICE

When Yarrow, in the year 1913, at the age of seventy-two, left Scotland, and made his home in the south, it was generally supposed that the long chapter of his active public life was closed, and that what remained to him was the rest and enjoyment of a peaceful and happy home, surrounded by friends, pursuing those quiet interests which could be carried out in the calm atmosphere of the country, rather than in the shipyard where so much of his previous life had been spent.

After a journey with his second son Norman through Canada to British Columbia, which resulted in the works at Victoria being developed, Yarrow declared that his future life should be free from the responsibilities of an active shipyard, which would gradually devolve upon the younger members of the firm, and that in the many and varied interests which had grown of late into prominence in his life, he would find ample compensation for the loss of the stimulus and excitement previously found at the works. To

retire would be impossible, he declared in 1913, but to keep in touch with everything of paramount importance by constant interchange of visit, daily telephonic conversation, and correspondence, would give him the interest he desired. His attention must, he felt, now be devoted to vital points in policy, so that whilst maintaining his guidance at Scotstoun, living at a distance would prove not only a practical possibility, but in this way his experience would be of even more value to his firm than long days spent at the works, days too often swamped in that routine and detail which others could carry out equally well.

On August 4, 1914, ten months after Yarrow left Scotland and abandoned his daily personal touch with the works, war was declared.

Then came that stupendous struggle, whose battle-cry roused not only Europe, but, penetrating into every continent, brought men and women from the uttermost parts of the earth, and held in daily thrall the heart and the Press of the whole world by its undying record of infamy and lies, of pain and death, of heroism and sacrifice.

To the last moment Yarrow, like many other far-seeing people, did not believe that war was imminent. He often stated that the commercial classes of Germany would never risk their world-wide success and extraordinary prosperity by consenting to a world-war, and during June and July, when feverish activity was apparent in naval circles, he remained calmly in his home watching events.

The hour sounded, the blow fell. On August 4 the truth was known, and without a moment's



NORMAN YARROW

hesitation Yarrow gathered together his resources and placed them at the disposal of his country.

It need hardly be said that, war having been declared, Yarrow plunged with renewed vigour into all the work possible for him, and it is because of his war work that a new section is of necessity added to this book, already longer than was intended by the writer. From August 4, 1914, Yarrow spared no effort to increase the output of his works, infusing energy and enthusiasm into all who came in contact with him; and in the record of the work carried out by the firm, the magnetic influence of its chief, now more than seventy years old, must not be forgotten.

The first official intimation of war reached the firm on August 5, at four o'clock:—

“*Miranda, Minos and Manly* to be accelerated forthwith.”

On August 6 Yarrow put on the order board two stock destroyers at his own risk, and the material for these vessels was ordered immediately.

The following letter to the Controller of the Navy shows his attitude in placing at the disposal of the Admiralty the experience of his firm:—

“I have been considering if it is possible for us to be of any use to the Admiralty in this crisis in any other way than by building destroyers.

“Should it happen that the exigencies of the time make it necessary for more destroyers to be rapidly built than can be constructed by the firms specializing in such vessels and who are probably already fully occupied, and should it therefore be desired that fresh firms be employed in destroyer construction, we should be quite willing to permit any of the firms on the Clyde to inspect the destroyers we are building, and to allow their people to gain whatever information they desire,

so as to facilitate such firms in carrying out the requirements of the Admiralty.

"I wish to make it clear that we want no remuneration, should we have the privilege of assisting the nation in this way."

Yarrow's eldest son, Harold, represented his father at Scotstoun, where 3,000 of the highest-skilled men were employed, and where the machines never ceased working night or day.

His son, Eric, in a touching letter, made it clear to his father that to remain in the works and assist in pushing forward special vessels for the Navy, however useful this might appear, was no longer possible to his father's youngest son. He joined the 7th Argyll and Sutherland Highlanders, and in May, 1915, this splendid boy, one of the most attractive personalities of his day, both at school, at Cambridge, and on the battlefield, never forgotten by any who came into personal touch with him, was killed by a shell at Ypres.

In a speech to his leading people at Scotstoun, soon after his son's death, during the feverish activity of war work, Yarrow said :—

"The Germans are attempting to enslave and destroy everything and everybody standing in the way of their aggrandizement. No words are strong enough to describe these bloodthirsty tyrants who have loosed a flood of sorrow on the world. Our best and bravest are being struck down in the flower of their youth, and our peaceful land is transformed into one huge military camp.

"From Belgium and Serbia comes the cry of a homeless people robbed and mutilated, and in our midst is mental and physical suffering unknown before in the history of our race.



HAROLD YARROW



ERIC YARROW

“We must fight on until we obtain success, and until the final hour of triumph, so that we may secure freedom for humanity from the threatened Prussian yoke.

“We owe this to our beloved ones who have given their lives in the cause of true civilization.”

To those who have read the account of Yarrow's link with the Admiralty during forty-five years, it is apparent that right through his life he exercised a real influence upon the speed of war vessels, and it must be evident from this simple record that the development of Yarrow's shipyard and the increase of speed and efficiency went hand in hand.

It was due to Yarrow's suggestion in 1912—to Admiral Jellicoe in the first place, and to Mr. Churchill later, both of whom showed the utmost willingness to gain from the experience of an expert—that the high speeds ultimately obtained by the firm, and followed by others, were secured. There can be no doubt that this increased speed in destroyers had an important effect in the performance of this section of the Navy during the War.

When Mr. Churchill became First Lord, shortly before the War, Yarrow approached him on the subject of further improvements, and stated that if the Admiralty would place an order for three vessels with him, leaving his firm a free hand in the design, he would promise improvements over the *Firedrake*, *Lurcher* and *Oak*; also, Yarrow added, that these vessels, if built, would add to the reputation of the Navy, as they would be the fastest ships afloat. Mr. Churchill ordered the vessels, which were named *Miranda*, *Minos* and *Manly*, and a further advance in speed of about 2 knots was obtained.

It was owing to these far-reaching decisions on the

part of Admiral Jellicoe and Mr. Churchill, that the future design of the destroyers built all over the country was determined. Yarrow proved beyond question that if properly built, vessels could be constructed with high speeds, without failure in strength of hull or in seaworthiness. It is notable that there is no case of a Yarrow boat having been found deficient in strength under war conditions.

During the War, by successive improvements in similar destroyers, still higher speeds were reached at Scotstoun, until the *Tyrian* obtained within a fraction 40 knots, fully equipped and with fuel sufficient for 1,000 knots. Admiral Sir George Goodwin, Engineer-in-Chief at the Admiralty, in his speech on March 7, 1919, at the "James Watt" dinner said:—"A destroyer from the Clyde gave the record speed on the measured mile," referring to the Yarrow boat *Tyrian*, the fastest vessel in the world.

In every case the vessels were tried under Admiralty conditions on the deep-water mile at Skelmorlie, where the results obtained are recognized by naval architects as being beyond question.

Twenty-nine of these destroyers left the yard between the declaration of war (August 4, 1914) and the Armistice (November 11, 1918). The performance of each boat was followed by Yarrow, who personally visited the ships when this became possible. The acquaintance of each commander was sought, and constant inquiries were made as to the condition of every ship and its machinery.

A list of the destroyers sent out to the War between 1914 and 1918 shows one section of the work turned out at the yard:—

TORPEDO-BOAT DESTROYERS

<i>Laverock</i>	<i>Musketeer</i>	<i>Sybille</i>	<i>Tuscan</i>
<i>Miranda</i>	<i>Nerissa</i>	<i>Torch</i>	<i>Tyrant</i>
<i>Minos</i>	<i>Relentless</i>	<i>Tomahawk</i>	<i>Tyrian</i>
<i>Manly</i>	<i>Rival</i>	<i>Truculent</i>	<i>Ulleswater</i>
<i>Moon</i>	<i>Sabrina</i>	<i>Tryphon</i>	<i>Vivacious</i>
<i>Morning Star</i>	<i>Strongbow</i>	<i>Tumult</i>	<i>Vivien</i>
<i>Mounsey</i>	<i>Surprise</i>	<i>Turquoise</i>	

Japanese Destroyer : *Urakase*

Italian Destroyer : *Audace*.

It is improbable that Yarrow had ever dreamed that his life-work, viz. the promotion of high speeds, would be put to such vital test as in the Great War. Although every detail of his work had been for thirty years considered in a manner which might seem to have assumed the imminent outbreak of naval hostilities, Yarrow in his own mind believed that, as far as Great Britain was concerned, these high-speed hounds of the sea would die in peace.

It may be mentioned in passing that it was due to the firm's success with the destroyers and the Tigris flotilla, and through the insistence of Lord Fisher and Admiral Jellicoe that he was honoured by a Baronetcy, and was congratulated by the latter in the following letter :—

“ H.M.S. *Iron Duke*,

“ 17/1/16.

“ MY DEAR SIR ALFRED,—I have been intending for some days to write to congratulate you on the honour conferred on you which is so richly merited, both by your work before the War and for the work since war began. It is a very tardy

recognition of services, the value of which to the nation has at last been realized, and I am glad to say recognized.

"I have been so overwhelmed with work that private correspondence has fallen behind, but believe me that *no one in this country* is more fully aware than I am of the justice of the honour you have received. May you live long and in peace.

"The *Morning Star* came through an exceptionally severe gale the other day in splendid style. I have reported officially that the sooner you DESIGN and build many more T.B.D.'s the better for the country. No weakness was apparent anywhere!! Every good wish, from

"Yours sincerely,

"J. R. JELlicoe."

The accounts of the work carried out by these destroyers are to a great extent those generously given by the commanders of the vessels themselves, and in such records it will be realized that the consummation of the life-work of the subject of this book meets its fulfilment. Surely it may be called Providential Justice that, after fifty years devoted to ship construction, this veteran now saw before him, in the fastest ships afloat, the most efficient engines of war put to their actual test in the service of his country, carrying out successfully a world-wide struggle with the ruthless foe determined upon her conquest.

Yes, during four years of the greatest war the world has ever seen, the Yarrow fleet of boats came into their own, and their constructor watched over them, following every record of their performance, glorying in the deeds of honour carried out by their officers and crews, with a pride and keenness only known and understood by those capable of concentrating upon, and carrying out, a great life-work.

Many a destroyer's crew will remember the practical interest taken by Yarrow in their personal comforts, which meant so much in those long vigils in the North Sea. And in this connection a rather amusing incident occurred. Among the articles presented to each destroyer built by the firm during the War, were sheepskin coats for the officers. One officer, who was about to take over the command of a destroyer, wrote to Yarrow to ask that the sheepskin coats might be dyed black as they showed up at night in the glare of the searchlights of the enemy. Yarrow invited tenders from three furriers for these special coats. Two declined to quote, because, they said, black dyes could not be obtained. They explained that before the War the dye came from Germany, and all supplies had now been stopped. The third firm, however, accepted the order. When the coats were finished, Yarrow called to see this firm, to ascertain how it was that only this one firm was able to obtain the black dye. On asking how it was managed, he was told that the coats were not dyed, but were made from the skins of black sheep!

Yarrow often tells his friends he has at last discovered a good use for black sheep, should they happen to possess any in the family.

It must not for a moment be supposed that, in writing this section from a destroyer point of view, it is intended to raise any controversy as to the comparative usefulness of the different types of ships engaged in the War. Every type of ship, from the smallest coastal motor-boat to the largest battleship, bore its heroic part, and faced with undismayed courage its every adventure. But this story is of

the Yarrow destroyers and what fell to their share of adventure and glory. In the North Sea, and around the coasts of Great Britain, Belgium, France, Portugal and Germany, night and day, these boats raced to and fro, in and out of every harbour on our coasts, never idle, at Zeebrugge, Jutland, Heligoland; on the Dogger Bank, round Scapa, they carried out their never-ending toil; every possible duty requiring speed and involving danger falling to their share. And the constant cry of the naval leaders was "destroyers," "more destroyers," "and yet more."

The possibilities of a destroyer, and the many purposes for which it could be used in war, had been from the first grasped by the firm, and they never failed to keep prominently before them the one condition necessary if a destroyer is to fill her place in the Navy. Speed is essential. A destroyer must catch everything else, must be able to escape, must be able from her speed and handiness to choose her position, to advance and retire at will, to attack and to run away as she desires, to get in and out of harbour or base easily and swiftly, and yet to live in every storm. She must be self-supporting for the longest distance, or able to form a unit in a small flotilla.

The actual work of destroyers during the War proved in practice so wide and varied that, without this racing craft, many of the naval operations would not have been possible. There was no engagement at which they were not present (excepting, for obvious reasons, the battles on distant seas, such as the Battle of the Falkland Islands). As dispatch-boats they were unequalled. As rescue ships they did heroic



DEPTH CHARGE EXPLODING



TELL-TALE OIL PATCH TAKEN FROM AN AEROPLANE

work, of which some dramatic records follow. As a bodyguard to our great and costly battleships they were invaluable. As scouts they obtained information of every kind. They examined neutral ships suspected of contraband.

In attacking at a distance of 4 or 5 miles they were able, in favourable conditions, to sink the largest battleship by torpedoes.

In addition to being armed with quick-firing guns, torpedoes and anti-aircraft guns, they carried depth-charges, a special kind of mine which is thrown overboard, and sinking, explodes with great violence when a certain depth of water is reached. It should be explained that when a submarine is sighted, the destroyer races to the point where it was last seen and drops these depth charges which explode under the water, and cause such a tremendous compression in every direction that a submarine in the vicinity is likely to be destroyed, either by being blown up, or by collapse owing to the pressure on the outside. The accompanying illustration shows the effect of a depth charge on the surface of the water. Evidence of such destruction is often obtained by the oil from the submarine rising to the surface of the water, as is seen in the aerial photograph.

In considering the work carried out by the Navy it must always be remembered that the primary aims of the Fleet were:—

(1) To enable the Army to reach its battle-ground abroad.

(2) To protect from submarine attacks the convoys of merchant ships which bring us food and raw material. (For this purpose the destroyer was often accompanied

by a balloon, which might discover the position of a submarine from the wake of its periscope, as seen in the aerial photograph.)

(3) To prevent the enemy from landing on our shores.

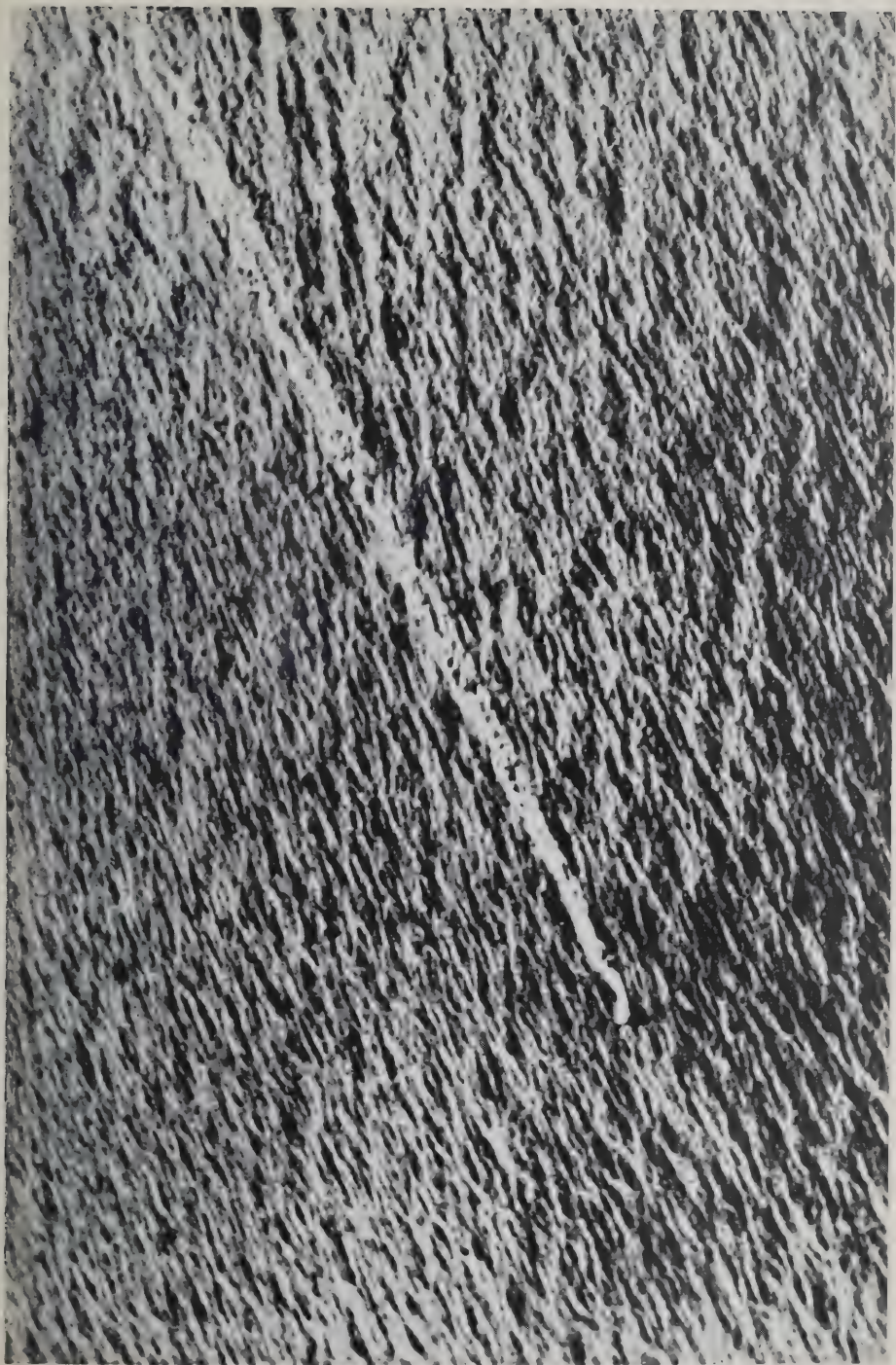
(4) To prevent the enemy receiving supplies of food and war material from overseas.

(5) To produce a smoke-screen.

(6) To sink the ships, and harass the flank of the enemy whenever he approached our coast.

(7) To save our ships for these manifold purposes until peace was signed, and the German High-Seas Fleet had surrendered.

These aims were successfully accomplished, and in their magnitude carried out almost without public notice. Yet it was through this work that Britain was saved, although at times it may have appeared to an emotional and excitable populace that the Navy was devoid of dramatic victory. No doubt the public longed for heroic details, to be compared with the lurid accounts of Nelson's day, and to many it may have seemed that, in comparison with the past, the Navy had become a dull service. True, there was no seizing of treasure, no grappling of ships in hand-to-hand fight, no boarding of the enemy's decks, no sailing into the enemy's ports, which were sown with explosives at every entrance. There was no destruction of ships while the enemy's Admiral slept, and little fighting by night. But let it never be forgotten that our Fleet carried out its aim to the last detail. To use Lord Fisher's expression: "Every soldier had to be carried on the back of a sailor." Our troops were transported in safety to the fields of battle, over twenty-one million men were moved across the



WAKE OF A PERISCOPE AS SEEN FROM A BALLOON



A CONVOY PROTECTED BY DESTROYER FROM SUBMARINE ATTACK

seas in comparative immunity ; there was no starvation in our land, and the German High-Seas Fleet was handed over unconditionally after 1,570 days of war.

A complete history of the Great War in its true perspective has yet to be written, and the author cherishes the hope that the naval portion of such a book may come from the pen of an officer of a destroyer, because in no other department of the Fleet was there the same opportunity for seeing every phase of our Navy's work in defending Britain's shores.

It is exceedingly difficult, and would require the latest film development to get a true picture of the life and work of a destroyer, either at her baptism of fire, or at any time throughout her life of unceasing adventure. The modern naval officer is, by nature, training and tradition, a modest and reticent person, preferring the sword to the pen ; and even when lured into mysterious confidence or persuaded to describe the performance of his ship and his men, his written accounts do not err on the side of diffuseness or imagination, but resemble more closely an official report of bare statistics. If occasionally of picturesque phraseology, they cannot be said to lean towards boastfulness. Therefore, the most thrilling and adventurous episodes of the whole century—deeds which, for daring, quick decision and hairbreadth escapes outrival the accounts of Trafalgar and the Nile—are generally recorded in language resembling the following :—

“ *Petard*, *Nerissa*, *Turbulent* and *Termagant* also pressed home an attack on enemy battle-cruisers, firing torpedoes.”

And again :—

“The King has been pleased to approve the award of the following honour, decoration and medals in recognition of gallantry in the action between H.M. destroyers *Mary Rose* and *Strongbow* and three German light cruisers which attacked a convoy, October 17, 1917.”

It is difficult to visualize anything of the reality behind the above curt sentences—the fierce excitement, the giving and carrying out of orders in the midst of bursting shells and flying fragments, the unrivalled bravery shown in the daylight attack on enemy cruisers, never attempted before. The impressions and experiences of men in the midst of such action cannot be described, and we can but echo the words with which Lord Jellicoe concludes his report of the Battle of Jutland: “This attack was worthy of the highest traditions of His Majesty’s Navy.”

The unimaginative official records, however, teem with fragmentary references to destroyer work, showing this craft in all its varied capacity: attacking, defending, scouting, rescuing; sometimes leading into battle, sometimes acting as rearguard; decoying, chasing and standing by—evidence piled upon evidence of their mettle and marvellous versatility in action.

The story of these vessels, spontaneously given by some of the commanders, must thrill every British heart; and lest any should think that these smaller boats lacked heroic adventure, a few exploits of individual valour have been chosen from innumerable incidents, told by eyewitnesses, which happened on Yarrow boats, the *Lurcher*, *Musketeer*, *Mounsey*, and others.



A DESTROYER, ACCOMPANIED BY A KITE BALLOON



LANDRAIL WITH BOW CUT OFF

CHAPTER XXVII

WAR RECORDS OF DESTROYERS

The destroyer *Landrail* was commissioned at the Yarrow yard by Lieut.-Commander Owen six weeks before the War began. She was therefore in tip-top form when war was declared, and carried out important duties full of danger until hostilities ceased. On August 5, 1914, with her paint still fresh, she dashed into action, and, in company with the Thornycroft destroyer *Lance*, engaged the German vessel *Königin Louise* and fired what was actually the first naval shot in the War, expending 138 rounds of ammunition. Before sinking this monster, caught whilst sowing the sea with disaster by laying hundreds of floating mines, the *Landrail* rescued her captain who, seriously wounded, died on board. The little *Landrail* appears to have dashed about pretty briskly throughout the War, and there was not much of historical note in the North Sea in which she failed in one way or another to put in an appearance. She emerged somewhat battered, but alive, after three collisions.

In March, 1915, after taking part in the Dogger Bank incident she mourned her brave Commander Owen, who was invalided out and died soon afterwards. She was prominent in supporting air raids carried out on the German coast, and on one occasion had 35 feet taken clear off her bow in a fog during a raid of this

kind. She floated about helplessly for some forty-eight hours, and was then towed home. Soon she appeared again, busily bombarding the Belgian coast, and later made a good show at Zeebrugge. With H.M.S. *Baralong*, she sank a German submarine whilst attacking the S.S. *Corsican*, and took this ship in tow. She carried out rescue work, which was always a prominent feature in the duty of destroyers, saved survivors from a collier sunk at Dunkirk, and also from the *Maloja*, the sailors from these ships being landed at Dover. She was present in many raids, and belonged to the Dover, and later to the Dunkirk, Patrol, to which fell the work of protecting the most dangerous flank of our transports to and from France. One result of the unceasing vigilance in those stormy seas was that not a single transport on that passage—and the enemy knew these transports to be vital—was lost.

The following extract from a letter to Yarrow from the *Landrail* gives a vivid account of the sinking of the *Königin Louise* :—

“ On the 5th August, 1914, a German armed merchantman, the *Königin Louise*, was sighted about 11 a.m., being reported as having laid mines off the East Coast. The Thornycroft destroyer *Lance* and the Yarrow destroyer *Landrail* were immediately dispatched to attack her. The Hun ship was, at the commencement of the attack, probably heading for Hamburg. We took our positions, after overhauling her, some points abaft her quarter, to avoid the risk of being mined. Fire was immediately opened on her, and replied to by her, but our 4-inch guns outranged hers. These were the first shots of the War fired at sea. A heavy fight took place, shot after shot of ours telling on her, and many going clean through her. Finally, about 12.30, when she was on fire fore and aft, a

shot from the *Landrail* took her in the stern, and apparently put her steering gear out of action, as they seemed to lose all control, and she stopped. Shortly after she had stopped—by which time she was like a blazing pepper-pot—she turned turtle and sank. Meanwhile the boats were sent to the rescue of the crew, but few were left, out of a very large ship's company."

Account by Eng.-Com. Ranken of H.M.S. *Lurcher's* doings in the action known as the Battle of the Heligoland Bight :—

"We are proud to have such a sound ship to serve in. Though it is but our duty to do so, to the best of our ability, we should never have been able to keep the *Lurcher* in such perfect condition had the material not been there.

"The *Lurcher* has been a Flagship since the War started ; we acted in that capacity for Commodore Keyes, who was the prime mover in the destroyer attack. He was the Senior Officer, and was also in charge of all submarine operations. The *Firedrake* and ourselves, on account of our superior speed, worked with him, and we were not attached to any flotilla, and so far we had done more steaming than anyone.

"The penetration into the German Bight was a well-prepared undertaking, and was carried out in considerable strength. The advance was greatly assisted by the weather and poor visibility. The day was warm and balmy, a heat haze preventing clear observation, at the best periods, of more than about $3\frac{1}{2}$ miles, and often it was a great deal less. Frequently one saw no hulls, but merely masts and funnels, and sometimes only the smoke from the latter. Gunfire was often withheld on account of the uncertainty as to whether a ship was friend or foe ; and one of the most extraordinary features was that no actual collision occurred.

"The *Firedrake* and *Lurcher* were right in the thick of it. We had no casualties, and though we did no execution ourselves on account of the duties we had to fulfil, we saw more than anyone else.

"Early in the fight we were chased by three light cruisers,

but soon ran clear of any attention they might subsequently have paid to us. The resultant burst of speed had a pleasing sequel, for we presently sighted our battle-cruiser line of five ships under Sir David Beatty. As these huge vessels were then running at approximately 28 knots, and pressing on into the region of the fight, from which constant firing could be heard, the sight was most inspiring; they were, of course, cleared for action, and not a soul was visible on deck. Gradually we drew ahead and finally passed the *Lion*, which was the flagship. It must have been soon after our parting with the battle-cruisers that the *Lion* sank the *Köln* by two salvoes at close range—all on board, over 500, perished. The Germans also reported the loss of the *Ariadne*, after being fired at by the *Lion*, from which ship's view she disappeared into the mist in flames, but before sinking, the majority of her crew were rescued by their own side.

“Presently we came upon the *Mainz*, just being finished off by the *Liverpool*; she was a wreck; two of her funnels, and all her upper deck gear and masts formed a blazing mass amidships. She was settling fast by the bow, and had a heavy list to port, having been torpedoed.

“In her wake were about sixty to seventy men in the water amidst wreckage, some dead, some drowning; all were more or less wounded, some fearfully. They had belts on, and had been thrown overboard. Many had pistol bullet wounds inflicted by their own officers, and we observed several of the latter shooting their men on board the *Mainz*—the idea of this shooting is not clear, but it is an undisputed fact. We picked up as many as possible from the water, and then the Commodore made up his mind to risk going alongside to take off as many as could possibly be got at before the *Mainz* sank; we had taken about thirty from the water (the *Firedrake* had got the others, amongst them von Tirpitz, junr.) By this time all who could move on board the *Mainz* had come on deck, mainly from the engine and boiler rooms. The shooting of the men ceased as we ranged alongside, otherwise we should have pistolled the people who were firing. I had best draw a veil over the condition of her decks. I do not think that any of the people we got had been on the upper deck during the fight. We were alongside for less than five minutes, and in that time we

shipped over 200, the majority well enough except for slight cuts, splinter wounds, etc., but forty or fifty were in a more or less serious or fearful state; I say 'fearful,' because some had such awful wounds that the idea of feeling upset by the sights forced upon one was quite unthought of, at least by the majority of us. This state seems to be one of the saving clauses in such circumstances, providentially so, no doubt. By general good management on both sides, and good luck, not a single man fell between the two vessels, which were surging together rather badly.

"You can imagine the state of our decks—the congestion was serious, as we had 224 when we came to count them up, plus our own crew of over eighty.

"One and a half minutes after we cleared her side she dipped by the bow to port, and the last we saw of the ship was her screw-propeller—well polished too—we were afraid it would rip our side before we got away.

"This was at 1 p.m. on the Friday (we did not reach Harwich till 2.30 a.m. on Saturday). On sorting out the people we found fifty-five cases requiring such immediate attention as we could give them; all our dressings and applications were soon used up. The Germans assisted as far as they could; some of the men who were most terribly wounded had their chums who had stuck by them, and such couples were really rather touching.

"I had to cut off one man's leg below the knee—the part below that was pulped and the other leg was minus a foot. We had dreadful cases by the dozen, but we could not reasonably hope to cope with them successfully. The weather was perfect, in contrast to the conditions aboard; had it been otherwise, the state of these people would have been impossible.

"We settled down to a steady 26 knots, and at six o'clock fell in with the *Cressy*. By arrangement with her, we transferred 165 who could be looked upon strictly as prisoners. We were considerably relieved thereby, as we were not relishing the idea of having well over twice our own crew of more or less able-bodied men to compete with in the dark. We proceeded to Harwich with the remaining fifty-seven who could not be moved, and one German doctor and a Red Cross man. By this time fourteen had died, and by 1 a.m. others had also gone.

At 8.30 we slowed down, said a few words, and buried the dead. Of the thirty-nine eventually landed several have since died, some from the effects of the lyddite fumes.

“The German shells did not seem to have anything like the effect of ours—so much the better! Their gunnery was good, but our method of ranging the guns more effective. They seemed to suffer from bad coal, and their destroyers belched black smoke. The officer prisoners were morose at first, but relaxed a bit later, and such news as we got was more or less truthful, from observation of existing facts.

“One man with a very fat back had fourteen bullet wounds in his body, and yet he was comparatively cheerful and could walk with assistance. These wounds had been done by his officers. Many of the men shook us by the hand and said they were glad to be out of it. They suffered from a shortage of engineers; many were merchant people with no naval experience.

“That we were first back here was simply a duty. Please do not associate any of our doings with heroics; if we had not had your well-made ship under us it might have been different.

“All your ships were going well. The *Firedrake* and *Lurcher* were looked upon as two front-rankers by a long way.

“The sinking of the *Mainz* was virtually the closing incident of the Heligoland fight. The enemy, certainly in the latter stages, had avoided action rather than courted it, and our forces abandoned the pursuit of his scattered units.”

In giving this description of the Battle of the Heligoland Bight, there is no intention of discussing the tactical or strategic advantages gained by the British in the action, with which the foregoing account deals only in a very brief manner. But it may serve as a picture of representative incidents in this, the opening naval battle of the Great War.

It is more than mere coincidence, however, that in quoting a German admission of the superiority of British material, a fitting tribute is thereby paid to a famous shipbuilder.

“On the 28th August, when the German torpedo-boats found themselves confronted by British destroyers, without the support of more heavily armed ships, the great superiority of the individual British vessels became apparent. They were 20 to 50 per cent larger than their German contemporaries, and their armament was of such excellence that in gun actions the Germans were in the most unfavourable situation possible. The superior calibre of the British guns enabled them to fire at a greater range, and the effect of the German shell was not sufficient to stop or sink an enemy destroyer. The speed of the British destroyers was also superior, and they were such dangerous opponents that the German boats had to depend on cruiser protection throughout the engagements of the 28th August and obtained no success worth mentioning.”

Commander Ranken writes:—

“These extracts are typical examples of a naval action with all its attendant thrills and anxieties; but I ask the reader to accept the assurance, given in no vain spirit of boasting, that the general feeling amongst all those who took part is one of obliteration of selfish consideration. It is Nature’s provision when in the ‘Valley of the Shadow’ that such feelings should prevail.”

Extract from letter on board H.M.S. *Miranda*, dated February 1, 1915:—

“I suppose you saw by the papers that we had a lovely battle in the North Sea last month. It’s a battle I won’t forget for a while—it was a running fight for four hours. We sighted them at 6.45 a.m. As soon as they saw us they turned tail and ran, but we were not long in overtaking them. We started battle at 8 a.m., and it lasted until 12.45 p.m. The only thing I am sorry for is that they were too near home when we sighted them, for if they had been farther away from home they would never have got back again.

“Our battle-cruisers started firing at 18,000 yards—you must think that was a very long range, but I can assure you

that they were no dummies. They fought well, and so did the *Blücher*, but she had not the speed (only 25 knots), so she suffered, but I can assure you that there were two other ships badly damaged; they were all afire when the battle was stopped. Whether they reached home or not I don't know.

"Now I didn't think we would reach port again, for all our class of boat had orders to make a torpedo attack, so the *Meteor* and ourselves were the only ones in it. The *Meteor* got a shot in her foreward stokehold, and I just saw that bit. She was on our port beam, about 100 yards from us. It was a sight when they struck her. Then we were left alone—all the others were astern, so we had to stand the brunt. I was looking every moment for a shot to strike us, but we escaped unhurt, and so we had the pleasure of firing a torpedo at the *Blücher*; and the sinking of this ship I shall never forget—it was an awful sight. All her guns and upper deck were blown to pieces, and when she sank, she turned upside down. You ought to have seen those poor fellows struggling in the water; they were brave, but no one could live long that day in the sea. We had some awful sights on our ship. Out of the 250 that were saved from her we had 47—899 perished."

One of the *Mounsey's* adventures is worth recording. The story is told by an officer on board at the time:—

"On October 5th, 1918, H.M.S. *Mounsey* left Lough Swilly with seven other boats to meet a convoy of ships carrying troops from America. We met very bad weather—a gale blowing from the south-west; in consequence, we lost touch with the rest of the Fleet during the night.

"About 8.30 a.m. on the 6th the *Mounsey* sighted H.M.S. *Otranto* in distress, after having been in collision with the *Kashmir*, and totally disabled, having been rammed amidships.

"The Captain of the *Mounsey* decided to get as near as possible to render assistance; in the tremendous sea that was running it seemed an impossible feat. We came abeam of the *Otranto* on the leeward side, but the action of the heavy seas brought us together with an awful crash. We continued to

BLUENHER STINKING





H.M.S. OAK WITH HIS MAJESTY ON BOARD INSPECTING THE BRITISH FLEET PRIOR TO THE
SURRENDER OF THE GERMAN FLEET

go in and out with every sea. Each time we closed, men were ordered to jump on to the *Mounsey's* deck ; many were injured in doing so, and others missed us altogether, dropping between the two ships, and being crushed to death. Our Captain on the bridge was having some miraculous escapes from flying debris. . . . After twelve hours of exceptionally fine seamanship we reached Belfast.

"It is people who are acquainted with the construction of these light craft who can best appreciate the wonderful escape we had, nearly all our main bulkheads were buckled in by the ship's side being forced in. It speaks volumes for the fine workmanship in the construction of the ship, that not a single pipe or joint was carried away during the awful pounding we had."

Extract from the Official List of Honours :—

"The Distinguished Service Order was awarded to Lieut. F. W. Craven, R.N., in recognition of his services when H.M.S. *Otranto* was wrecked on October 6th, 1918. H.M.S. *Otranto* was damaged in collision with S.S. *Kashmir*, whilst carrying a large number of American troops. Lieut. Craven displayed magnificent courage and seamanship in placing H.M.S. *Mounsey* alongside the *Otranto*, in spite of the fact that the conditions of wind and weather were exceptionally severe. His action resulted in the saving of over 600 lives which would otherwise have been lost ; his performance was a remarkable one, and in personal courage, coolness and seamanship, ranks in the very highest order."

Report by Lieut. Charles G. Naylor, in command of the Yarrow destroyer *Musketeer* :—

"The *King Edward VII* struck a mine on the 6th of January, 1916, between the Pentland Firth and Cape Wrath, during a heavy gale.

"After leaving the builders' yard and proceeding to its base the *Musketeer* received orders *en route* to go with all speed to the *King Edward VII*. The call had been given to

other destroyers, but the *Musketeer* passed these and had rescued from 300 to 400 souls before their arrival.

“It is interesting to note, as showing the strength of the *Musketeer*, that the *King Edward* had overhanging sponsons, and while taking the crew off in a heavy sea, the destroyer got under the sponsons, which were descending with every roll of the ship on to the deck of the destroyer and severely punishing her, but the main structure was unhurt.”

The *Oak* was used throughout the war to keep up communications between the Grand Fleet at Scapa and the mainland, under the command of Commander Douglas Faviell, who wrote to Yarrow, on November 4, 1917, as follows:—

“I am sending you to-day a photograph of the *Oak*. To-day is the fifth anniversary of my taking the ship over from your firm, and in sending you this photograph I trust you will accept it as a token of my esteem and regard, firstly to you for the great interest you have always taken in the ship, and for your great personal kindness to us all, and secondly, to you as the head of the firm who built such a wonderful vessel.

“It may interest you to know that we still bear the reputation of never having had a breakdown which disabled the ship, never having missed a single operation with the Grand Fleet, and never having had to go to a dockyard or other repair base, except for our periodical refit. All examinations and adjustments have been carried out for the first seven months at an hour’s notice, and since then at two hours’ notice, for full speed. The ship can still get 33 knots in spite of all the extra weight built into her since leaving your hands. It has been a great joy to me to command the ship for such a long period, and under three successive Commanders-in-Chief. They have all spoken highly of her capabilities and readiness for instant action. It almost looks as if she is going to remain in her high estate throughout the War, all her contemporaries having been long ago relegated to work of a patrol and convoy nature.

"I am sure the above résumé will give you the same satisfaction as it has given me."

It is impossible, the writer feels, to say anything with sufficient warmth about Yarrow's splendid and devoted staff, who for so many years have supported him in building up the world-wide success of the firm. It must not be omitted that since Yarrow's partial retirement from active work his eldest son, Harold, ably represented his father, especially during the strenuous time of war, when work was carried out night and day, showing the quality of the men who were responsible for the boats their country needed.

The indescribable devotion of this little band of men to Yarrow, proved in many ways, not only in practical, continuous, unflagging effort, but in sympathetic affection and unselfishness not often found in business or industrial life, has been very dear to their chief, who is often heard to say that his business life has been filled with sentiment and friendship.

CHAPTER XXVIII

THE TIGRIS GUNBOATS

It will be borne in mind that Mesopotamia was, at the outbreak of war, Arab territory under the influence and suzerainty of the Turks, whilst Persia was independent, and had for long years been on good terms with the British. The harbours round the eastern side of the Persian Gulf, as well as Koweit, were Persian, and therefore friendly to us, but the towns on the river Tigris were in Turkish hands.

For over 300 years Great Britain had been represented in this part of the world, and she was unquestionably the most popular nation who had dealings there. No doubt the cruisers stationed in the Persian Gulf gave her prestige, but her position was due to tradition, treaties and progressive, peaceful influence more than to any other cause.

Germany, with her usual conscientious foresight, had for years before the War been working at a far reaching plan for weakening Great Britain's hold on India, and the only possibility of carrying this through lay in skilful co-operation with Turkey, whereby Germany might attain overwhelming influence in Mesopotamia and round the Persian Gulf. The most vital part of this scheme was the Berlin-Bagdad Railway, which would have established communication between Germany and Bagdad, and ultimately with Basra and the splendid harbour of Koweit, thus providing

—to borrow the Kaiser's own description—"a Germanic wedge reaching from Hamburg to the Persian Gulf." But Germany does things thoroughly, and so minor possibilities, such as peaceful persuasion by means of the establishment of an oyster shell business and the visit of a group of geological students, were not neglected. Fortunately for us, the persuasive methods tried on Persia were more or less unsuccessful. As the Anglo-Persian Oil Refinery Pipe Line from the wells upon which our ships depended for fuel was in Persian territory, it was of the utmost importance that our position there should be safeguarded, and that no risk should be run of our oil supply being cut off.

On October 24, 1914, Turkey entered the War as Germany's ally. On November 2 the British consuls left Bagdad and Basra, and the Turks and Arabs in these towns, supported by the Germans, prepared to fight. On November 5, 1914, war was formally declared between Great Britain and Turkey, and instructions were issued by our Government to send Indian troops to the Tigris. Basra, defended by the Turks, was entered after a skirmish by our Indian troops on November 22, 1914, and from that time the Mesopotamian Campaign, with Bagdad as its objective, lived in the heart of the British nation even as Ypres, Mons and Verdun.

Early in February, 1915, when Lord Fisher was in power at the Admiralty, he sent for Yarrow and told him that it was intended to place a number of gunboats on the Danube, that they must be superior in speed, and more powerful in armament than the Austrian gunboats already on that river. He stated that he

wished Yarrow to undertake the entire responsibility of designing and building these boats. Whether they should be steamed through the Dardanelles and up the Danube, or be shipped in pieces, carried across-country, and put together on the banks of the river, could not at that time be decided, because it depended upon whether the operations then in progress would enable our ships to pass through the Straits.

Lord Fisher also told Yarrow that twelve very shallow-draught gunboats were required for the Tigris, to police the river, and prevent the Arabs on the banks from firing at the transports carrying troops and supplies, as they passed up and down. These boats would have to be shipped in pieces and put together on the banks of the river.

Lord Fisher gave him an entirely free hand with regard to the design and construction of these twenty-four vessels, all of which were to be put in hand immediately and to be completed with the utmost possible dispatch. He relied on Yarrow to find out the most suitable type of gunboat, the necessary speed, and the limit of draught. Instructions were given him not to consult the Admiralty, because, as Lord Fisher explained, he had absolute confidence that Yarrow could bring the contracts for both types of vessels to a successful conclusion, and was anxious that nothing should arise which might cause the least delay. They could be built at Scotstoun, or they could be given out to those firms considered by Yarrow to be the most suitable for the work. It was pointed out that such a contract was unusual, and that sooner or later it would lead to trouble with the permanent authorities at Whitehall. Lord Fisher said Yarrow must take the work in hand at once, or be locked up in the Tower

of London. Yarrow said, "If I am locked up in the Tower, will you come and look at me through the bars?" to which Lord Fisher said "No." Yarrow then replied that he had no choice but to carry out what Lord Fisher desired, conditionally upon the technical part of the work being left entirely in his own hands. As to financial arrangements, he desired that some practical person should be appointed to look after the interests of the Admiralty, so that he might be freed from all anxiety, in which Lord Fisher concurred.

The vessels were to be known from the start as the Large China Gunboats and the Small China Gunboats, to conceal their real destination. The larger boats, if transported in pieces, were to be shipped to Salonika, sent by rail and re-erected on a tributary of the Danube in Serbia, and a piece of ground was actually chosen for the purpose. When, however, Bulgaria entered the War in 1915, and the Serbians were driven from the Danube, these vessels could not be used as originally intended, and it was decided to rivet them up and employ them for other work. Four were sent to the Tigris, viz. the *Mantis*, *Moth*, *Tarantula* and *Gnat*. Four were used to assist in protecting the Suez Canal, and the remaining four steamed up and down the East Coast of Great Britain in search of submarines.

The dimensions determined on for the twelve vessels originally intended for the Danube were, 250 feet in length by 36 feet beam, with a draught of only 4 feet. They were propelled by twin screws.

The smaller gunboats for the Tigris, Yarrow decided, should be 120 feet in length by 20 feet beam, with a draught of only 2 feet 6 inches. These were propelled by single screws.

All the vessels, both large and small, were fitted with Yarrow's hinged flap, described in a previous chapter.

The speed of the larger gunboats was found to be about 18 miles an hour, the armament consisting of:—

Two 6-inch guns on the main deck.

Two 12-pounders.

Six Maxim rifle-calibre guns on the battery deck.

Two Pom-Pom anti-aircraft guns.

The smaller gunboats realized a speed of 10 miles an hour, and their armament was:—

One 4-inch gun on the main deck forward.

One 6-pounder on the battery deck, with alternate positions at the forward and after ends.

Four Maxim rifle-calibre guns mounted on the battery deck berthing.

These smaller gunboats were not originally intended to act against artillery, although as the War proceeded they did so with conspicuous success. It may here be stated that a single screw was adopted instead of twin screws for the smaller boats on account of the dispatch necessary in construction. Had time admitted, twin screws would have been selected.

After Lord Fisher had instructed Yarrow to proceed, the first step he took was to consult Mr. Baker, of the Experimental Tank at the National Physical Laboratory, in order to ascertain from experiments with models the most advantageous design of hull, and there is no doubt that the success of these vessels was in no small measure due to these preliminary experiments.

The smaller gunboats were entirely constructed in



TIGRIS GUNBOATS IN THE COURSE OF CONSTRUCTION ON THE CLYDE



A GROUP OF WORKMEN ENGAGED IN THE ERECTION OF THE GUNBOATS AT ARADAN

the Scotstoun Yard. The larger ones were designed by the Yarrow staff and built by various firms all working to a common design.

The smaller gunboats, whose lives were filled with adventure, were termed the "Fly" class. They were called *Firefly*, *Butterfly*, *Greenfly*, etc. Temporarily put together on the Clyde, they were shipped in pieces, then re-erected on the banks of the Tigris at Abadan, an island belonging to the Anglo-Persian Oil Company in Persian territory. Mr. William Grant, a valued member of the Yarrow staff, was appointed Admiralty Overseer in charge of the work at Abadan, and many were the difficulties he had to contend with.

He had to obtain his workmen from all parts of the country, and they were consequently of various nationalities, and of various religions. He was greatly troubled by the diversity of races and creeds to be dealt with—Indians of different castes, Arabs, Persians of all denominations, Chinese, men from the mountains of Afghanistan, etc., and one of the first things he did was to erect a temporary building in which those of the Eastern races might conduct their religious observances.

If a foreman wanted a tool such as a hammer, he would send two men to fetch it, because if only one man went, and if he were seized with a sudden desire to pray (falling on the ground for that purpose, in which devout occupation he must not be disturbed), the hammer might not appear for a considerable length of time.

Again, a man of one caste would not drink the water carried by men of another caste. Things had to be arranged so that if one caste of Indians were

taking a meal, the shadow of a man of another caste could not fall upon their food, thus rendering it unfit to eat. Each tribe, caste and nationality had different feast days and fast days. Add to these arrangements the babel of different tongues, none of which were spoken by Grant, in a climate where the temperature was at times 116° in the shade, and the confusion may perhaps be imagined.

Yet the rapidity with which the work was executed at Abadan, in spite of such strange conditions, may be gauged from the fact that the order was given by Lord Fisher on February 9, 1915, and the first gunboat—the *Firefly*—was fully equipped and commissioned on the Tigris on the 2nd of the following November, and actually began fighting two days afterwards.

The last of the twelve gunboats was commissioned on March 10, 1916, so that from the date of the order to the date of commissioning the first boat was nine months, and the remainder were commissioned at intervals of about eleven days. These periods embraced the building of the vessels and their machinery at Scotstoun, the transport to the Persian Gulf at a time when transport was difficult and uncertain, the re-erection, launching and equipping for service on the Tigris.

A floating self-propelled workshop for repairing the steamers was sent out. Also three stern-wheel hospital ships, 150 feet in length by 31 feet beam, were built and safely transported. Only those who remember the tragic accounts of the suffering of the sick and wounded throughout this campaign, and the lack of everything required or necessary for hospital equipment, can realize what these boats meant in this crucial

need, and although insufficient in number, without their speedy delivery many hundreds of lives must have been lost in untold suffering.

Having related the part that Yarrow and his firm on the Clyde, and Grant and his army of workers of various colours on the Tigris, were doing to support the Navy in Mesopotamia between February, 1915, and March, 1916, we will go back to the beginning of April, 1915.

General Sir John Nixon was in supreme command of the Expeditionary Force. Major-General Sir Charles Townshend arrived at Basra in April, 1915, and was given the task of driving the Turks away from their position north of Kurna, which is 112 miles up the river from the sea and 48 miles from Basra.

On May 31, 1915, the advance up the Tigris began, and a battle was fought at Kurna under most extraordinary conditions, for this is the season when the river overflows its banks, and the land becomes inundated for miles.

Water extends as far as the eye can reach. Occasionally there are oases of palm trees, here and there flat-roofed, mud-built Arab villages on slight eminences, and Turkish redoubts situated on small sandhills, resembling islands in the ocean. Consequently, not only the Navy, but the Army had to be afloat. Owing to the extremely limited transport facilities available, part of the troops had to advance to the attack in native, tub-shaped craft, called "bellums," which were poled through the reeds. A flotilla of 500 or more of these boats was formed. There were mountain batteries on rafts, and guns of various calibre on tugs, barges and steamers. The naval batteries proceeded slowly upstream, feeling for the channel

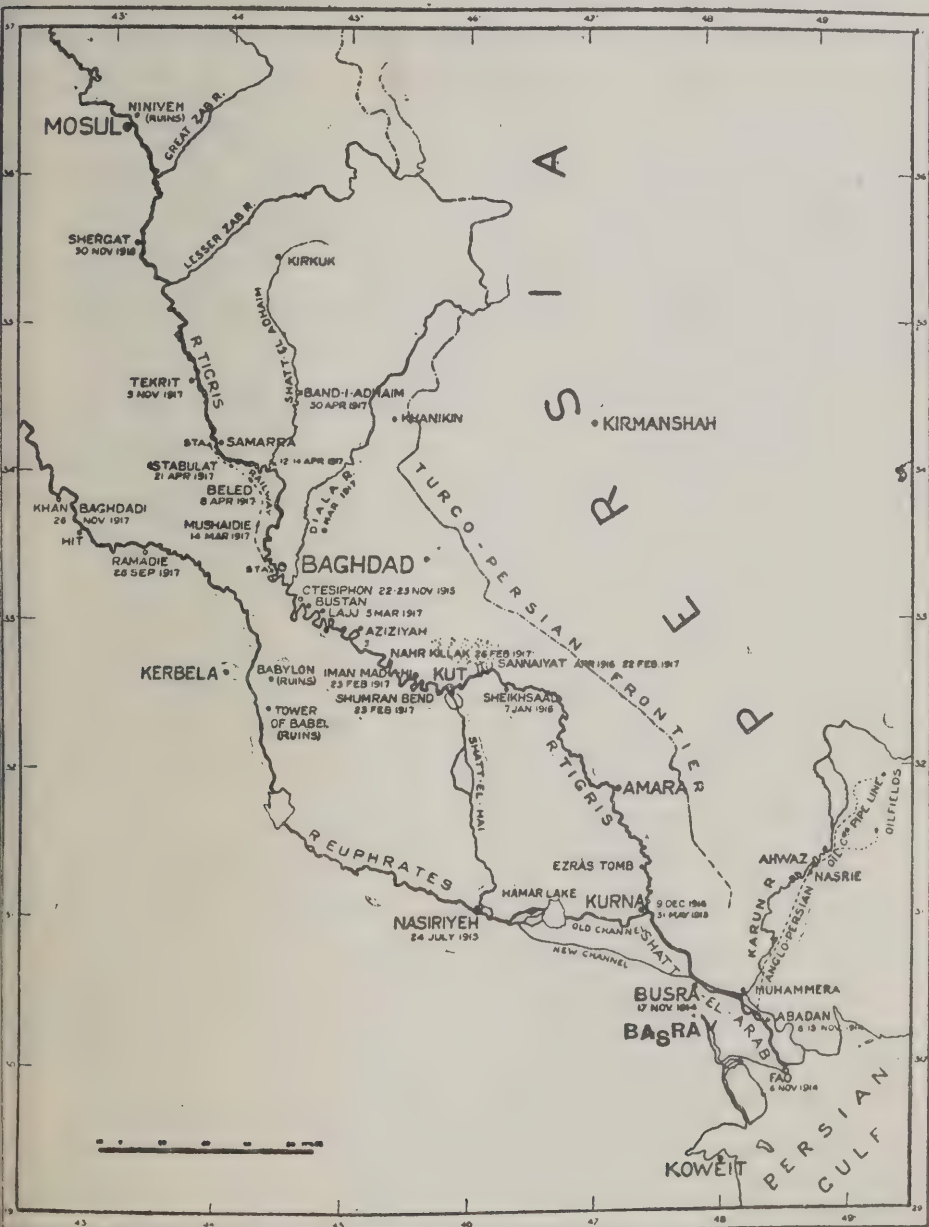
with caution, concentrating their fire on island after island occupied by the enemy. Under cover of this naval bombardment the British and Indian troops carried the enemy's trenches at the point of the bayonet, often wading waist deep through the water. Position after position was taken. The defence was completely overwhelmed by the volume of fire brought to bear upon it, and the Turks were seen scrambling into their boats and paddling and poling for dear life. The whole of the enemy's advanced position at Kurna was captured by noon.

Having won this extraordinary and dramatic battle a pursuit of 86 miles lay before General Townshend. At the end of that 86 miles was Amara, the most important town south of Bagdad. The pursuit was continued by a portion of the naval flotilla, i.e. those few boats of shallow draught capable of navigating the shallow waters now reached, and Amara (134 miles up-river from Basra) was captured on June 3. The garrison of the town was completely taken by surprise and surrendered to General Townshend, and to the Senior Naval Officer, Captain Nunn.

The next point to be reached and conquered was Nasiriyeh, on the Euphrates, which joins the Tigris at Kurna. (*See Map.*) A decisive action was fought on July 24, and the next morning the Union Jack was hoisted on the barracks.

On September 26 General Townshend again got into touch with the enemy, and the battle of Kut commenced. Severe fighting ensued on the 27th, and by 2 p.m. on the 28th the whole of the northern part of the enemy's position had been captured. The next objective was to fall on the rear of the Turkish force, but before this movement could develop, strong

enemy reserves were seen advancing from the south-west. They were quickly checked by a bayonet charge. Although our troops were exhausted by heat, thirst,



and the long marching and fighting without sleep, they hurled themselves on the Turks and precipitated their rout. This decided the action. By nightfall

the enemy was beaten, and Kut was occupied by General Townshend the following day, September 29, 1915. The battle of Kut will be remembered as one of the most brilliant actions fought by our troops.

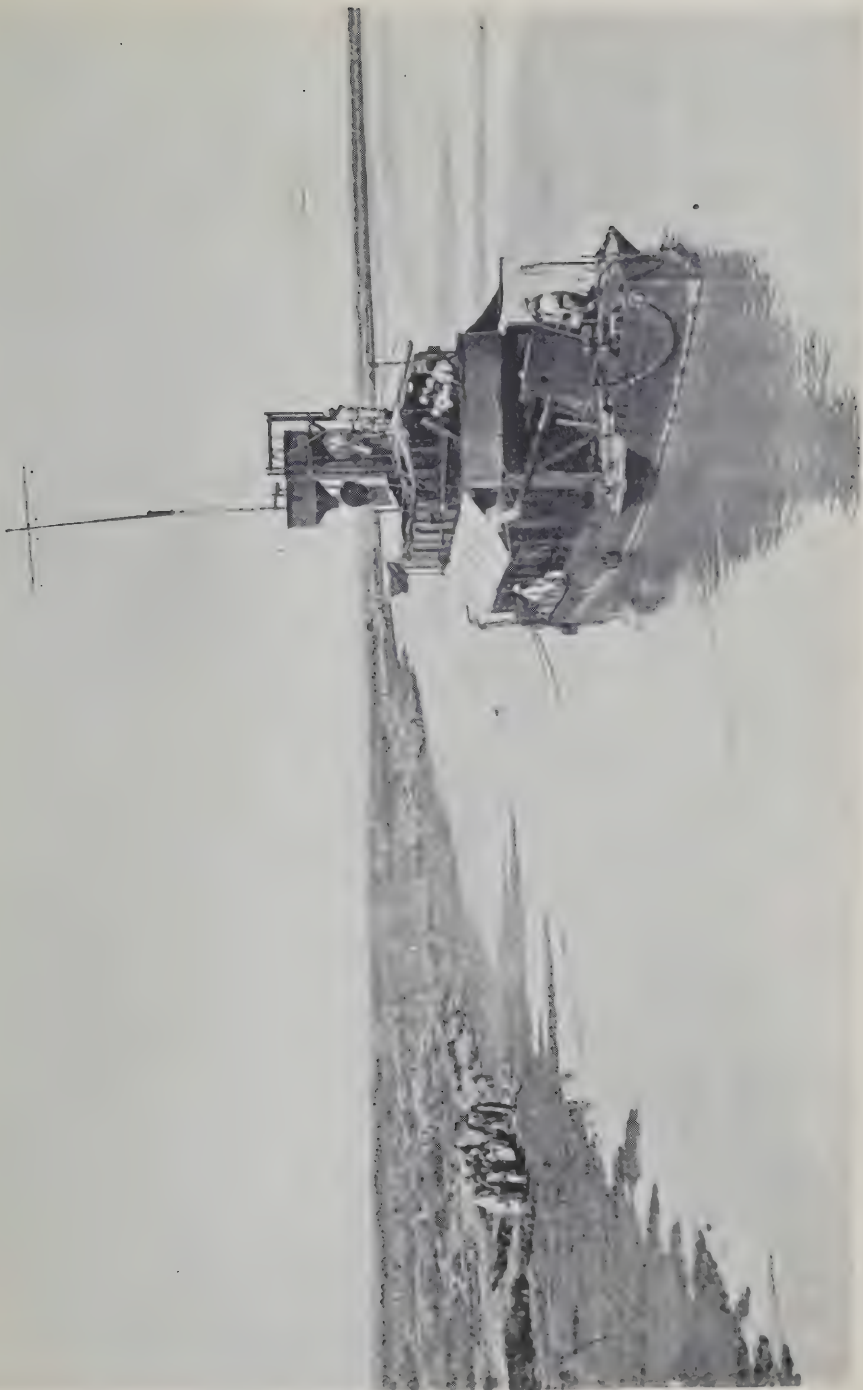
By October 5 the pursuing naval and military forces had advanced to Azizyeh, and the Turks had retreated to Ctesiphon, where they took up a strong defensive position, astride the Tigris, 18 miles south-east of Bagdad, barring the road to that city. The challenge was irresistible. One more victory like Kut, and we should be within a day's ride, a long day's march, of the capital.

On November 11, 1915, the first advance on Bagdad began, and the battle of Ctesiphon commenced on November 22. The fighting lasted throughout the day; the Turkish troops were beaten again and again, but we had no reinforcements to oppose the fresh troops constantly brought up against us. Captured trenches changed hands several times, and, in the end, our line was too thin to hold the extended position already won. On the 23rd we were unable to renew the offensive. That night, and on the 24th, counter-attacks had to be repelled. On the 25th the Turks again received fresh reinforcements. There was no alternative but to retreat.

Our forces fell back on Kut, and it was realized that the attempt to reach the citadel of Bagdad, the actual objective of the campaign, had failed.

Kut was re-entered by General Townshend on December 3, 1915. Preparations were immediately made to defend the town, and the siege, which began on December 7, 1915, lasted until April 29, 1916. Three desperate attempts were made to relieve the besieged garrison, but they were unsuccessful, because, in

A CITY BOAT ON THE TIGRIS





THE LAUNCH OF THE *FIREFLY* ON THE TIGRIS

addition to the strength of the enemy, all through those difficult days our troops had to fight the Tigris and the marsh as well as the Turks. Many of the trenches became neck-deep in water. When the order to advance was given, the troops had to struggle along knee-deep in mud and water, often to find, at the critical moment, the breeches of their rifles choked with mud.

It was towards the end of the advance to Ctesiphon and during the subsequent retreat on Kut that the *Firefly* had such an eventful, if brief, career as a unit of the British Navy. It should, first of all, be mentioned that at this early stage of the campaign she was the only specially designed gunboat at the disposal of the naval forces. Other boats were in use as gunboats, but they were merely commandeered passenger and cargo steamers, steam launches, tugs—in fact, any craft upon which a gun could be mounted.

The *Firefly* was handed over to the Navy, ready for action, at Abadan, on November 2, 1915. On November 11 she took General Townshend up-river to direct the operations towards Ctesiphon, and, during the subsequent advance, she assisted in the attack by bombarding the enemy positions. When the great retreat commenced, she supported the retirement of our troops, firing on the enemy as fast as her guns could be loaded. Among her many activities was the saving of the cargoes from stranded and disabled barges, and the towing of steamers off sandbanks, often under fire from Turkish guns and snipers. On November 28 she assisted in saving the guns and stores of an armoured tugboat.

On December 1, at daybreak, a large force of the enemy was seen encircling the British camp. All

stores were hurriedly burnt, and the retreat commenced. By this time the enemy had brought their artillery and machine guns close to the river-bank, and were pouring a murderous fire into the ships. A Turkish shell pierced the boiler of the *Firefly*, totally disabling her, and causing her to run aground. Her commander (Lieut.-Commander Eddis) was wounded, and she had to be abandoned. She was taken possession of by the Turks, who repaired the damage, and used her for a period of over twelve months—until her recapture by the British on February 26, 1917.

After the loss of the *Firefly*, four more boats of the "Fly" Class were hurriedly ordered by the Admiralty, bringing the total number of this type up to sixteen.

The second Yarrow boat to be completed at Abadan was the *Butterfly*. She was commissioned on November 23, 1915, in time to take part in the retreat to Kut. On January 6, 1916, this vessel was in action in support of one of the unsuccessful attempts to relieve the besieged garrison.

The third boat, the *Cranefly*, was handed over sixteen days after the *Butterfly*, and the remaining nine followed in quick succession.

On the night of April 24, 1916, the shallow-draught steamer *Julnar*, designed by Yarrow many years before, made a brave attempt to force the blockade and to get a cargo of 270 tons of provisions and supplies to General Townshend in Kut. It was a forlorn hope, but a gallant adventure. Lieut. Firman was in command, and Lieut.-Commander Cowley acted as pilot. The *Julnar* started on her venture at 8 p.m. Through the agency of spies her voyage became known, and the enemy had made preparations accordingly. They heard the noise of her engines, and she soon had to

run the gauntlet of rifle and machine-gun fire from both banks. Within 4 miles of Kut, in the darkness she struck some steel wire hawsers which the Turks had stretched across the stream. Her rudder became entangled and she was diverted into the bank. Her brave commander and her pilot were both killed, and the crew made prisoners. The last hope had vanished; the garrison was dying from starvation, and on April 29, 1916, General Townshend surrendered, after destroying his guns and equipment, and burning the tattered Union Jack which he had kept flying over Kut for almost five months.

After the fall of Kut there ensued a wearisome wait of nearly nine months, whilst the British force was strengthened, not only in numbers, but in organization and equipment of various kinds—in heavy guns, in aeroplanes, and especially in river transport, without which the forces could not be moved up, or supplied with food, ammunition, etc. In the meantime, the gunboat flotilla were actively employed in policing the river and in other innumerable ways, meeting with many adventures with Turkish outposts and Arab snipers by the way. The draught of these small gunboats, in fighting trim, was only 2 feet 6 inches, so that when the river overflowed its banks it was possible to save a considerable distance by cutting across the bends. As a matter of fact, the Arab pilots often showed the course over the shallows by walking up to the waist in water ahead of the vessel. On August 28, 1916, General Maude took over the command of the Mesopotamian forces, and on December 14 the triumphant advance which was to culminate in the capture of Bagdad began.

Space does not admit of following in detail the victorious progress of the Army, which was supported by a flotilla of Yarrow gunboats, both of the large and small type, under the command of Captain Wilfrid Nunn. In his Report, dated September 21, 1917, Captain Nunn says :—

“ On the forenoon of February 24, I moved up-river with *Tarantula*, *Moth*, *Mantis*, *Butterfly* and *Gadfly*, and arrived at Kut-el-Amara at 9.30 p.m., where I landed and hoisted the Union Jack. . . .

“ Early in the morning of the 25th I moved on up-river and communicated with our troops near Shumran. . . .

“ The enemy evacuated their position during the night, and we pushed on with the Army on the morning of February 26.

“ It soon became evident that the Turkish Army was much demoralized, and I received a message from General Sir F. S. Maude during the forenoon to push on and inflict as much damage as possible.

“ We proceeded at full speed in the *Tarantula*, *Mantis* and *Moth*; the *Gadfly* and *Butterfly* following at their utmost speed. . . .”

It has been said that the part now played by the Yarrow gunboats in the advance was of the utmost importance, and that the action of the Navy in pressing the pursuit of the enemy resulted in such disastrous consequences to the Turks that it determined the fate of Bagdad.

On February 26 one of the British columns tried to accomplish a big stroke by cutting across a bend of the river, believing that they would thus overtake the enemy. A forced march was made of 18 miles across the dry desert, but at the end of it they found that the Turk had been too quick for them, and it is probable that the enemy would have succeeded,



ONE OF THE LARGER GUNBOATS

THE MANTIS



in spite of every effort, in effecting an orderly retreat had it not been for a daring exploit on the part of the gunboats.

The Turks and Germans were retreating, driven back by the Navy and the Army acting together, when the Tigris Flotilla came to an exceptionally sharp bend in the river, and it was realized that the enemy's trenches and gun emplacements were situated all round the bend so that as the ships passed an inferno of shot and shell came at them from three directions. The Turks had heavy calibre guns as well as field guns within a few hundred yards of the river, all blazing away at point-blank range; while from the trenches there came an accompaniment of machine gun and rifle fire to supplement the roar of the big guns.

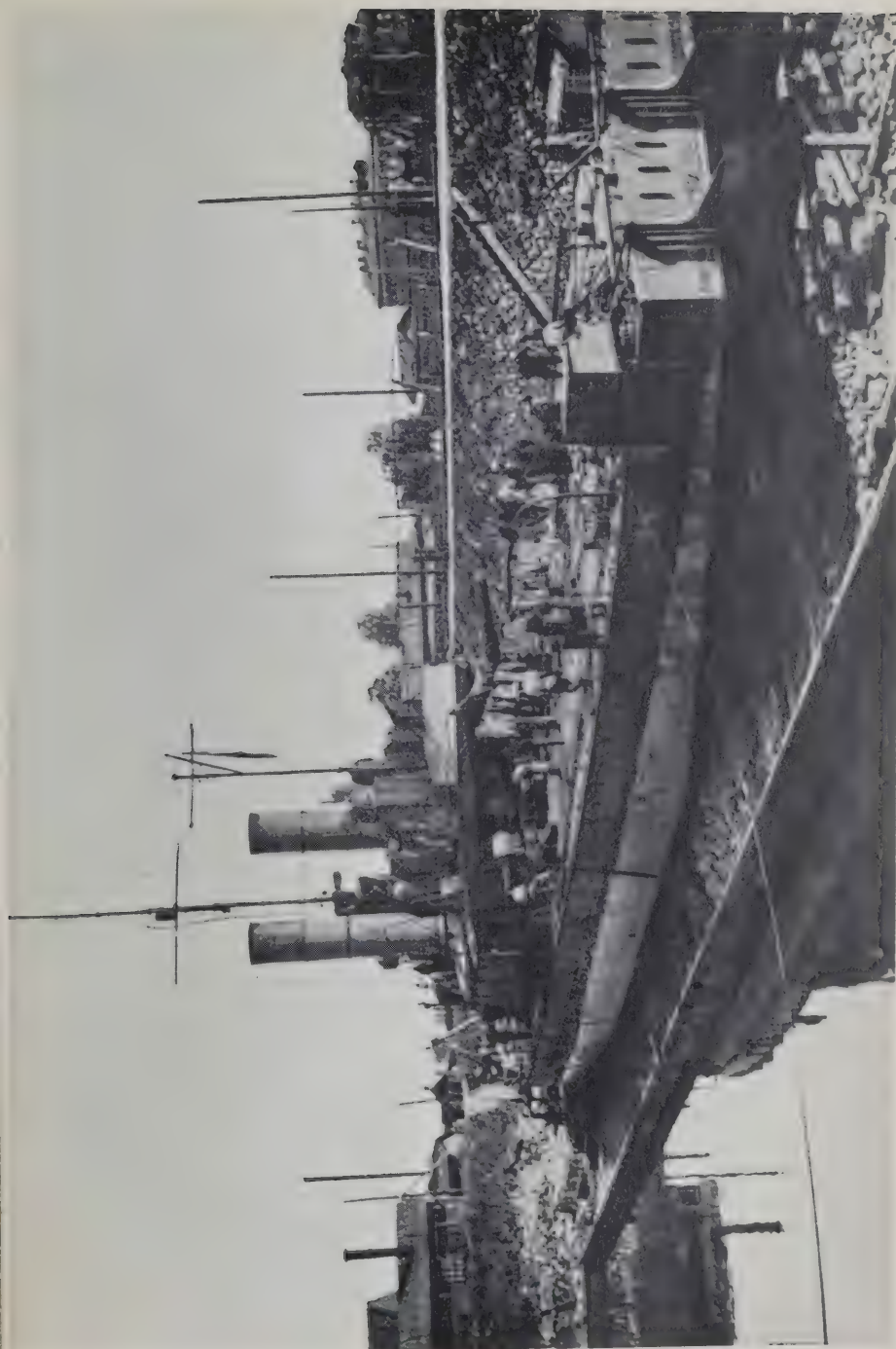
Five of the Yarrow gunboats took part in this wild dash round the Nahr Kellak Bend, the *Tarantula* leading, and as they swept past up the river, every gun they had was in action, from the 6-inch down to the Maxim. The range was something less than 500 yards, the kind of distance at which the old wooden walls of England used to open an engagement with muzzle-loading guns and red-hot cannon balls. The fury and deadliness of an artillery duel with modern guns at such range almost baffles the imagination. Every ship was hit several times, but still they held their course, and not one of them was disabled. The *Moth*, last in the line, came in for the worst fate. Two of her men were killed outright, and of her small complement more than half were wounded, including Lieut.-Commander Cartwright. She was hit eight times by shells, and her after-compartment was holed below the water-line, yet still she

managed to keep on forging ahead. The *Mantis* also had a heavy casualty list. Her quartermaster and pilot were killed in the conning tower, and Captain Buxton himself then took charge of the wheel, just in time to save his ship from running ashore. Though he had never seen that part of the river before, he managed to steer her most skilfully through the shallows.

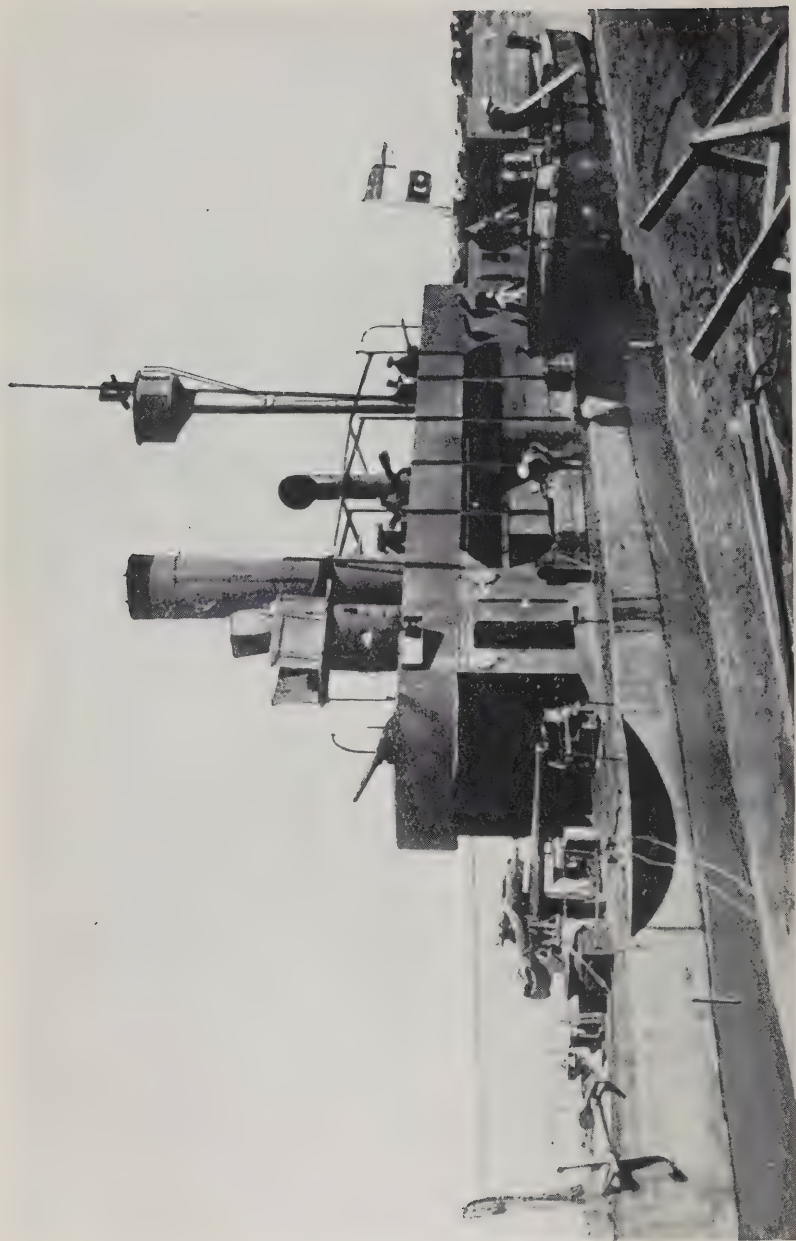
The enemy's retreating rearguard was passed, and before long our flotilla came up with the main army, and opened fire with everything they could bring to bear—heavy guns, secondary armament, pom-poms, Maxims, and rifles.

An indescribable scene ensued. The enemy's gunners were shot down, their abandoned guns being picked up later by our advancing troops; munitions and stores were scattered wholesale, rifles, even haversacks and water-bottles were discarded. The greatest wonder of all, it is said, was that the Turkish soldier was seen to run, for in normal circumstances nothing could ever make him do more than slouch along, either in advance or retreat. Up to this point the enemy had been conducting an orderly retirement. The prompt action of the gunboats, which converted the retreat into a panic-stricken rout, may be said to have decided the fate of Bagdad and the success of the Mesopotamian campaign.

It was not long before our flotilla came upon the Turkish fleet, and the first vessel within range was the *Sumana*, one of our boats previously overpowered at Kut. She surrendered, and was restored to her rightful owners. Several Turkish transport steamers hove to and gave themselves up, and about five



ONE OF THE LARGER GUNBOATS UNDER REPAIR



THE FIREFLY

SEE THE WHITE ENSIGN OVER THE CRESCENT

o'clock in the evening, the large steamer *Busrah* was brought to by a shell from the *Tarantula* and captured. She was full of Turkish troops, and was carrying German machine-gunners, of whom some were found killed and others wounded. But the prize on which the Senior Naval Officer had most set his heart was the *Firefly*, our gunboat lost to us during the retreat from Ctesiphon. Soon after six o'clock she ran into the bank within a mile or two of the spot where she had been lost by us in December, 1915. Her command was taken over by Lieut.-Commander Eddis, who had charge of her at Ctesiphon in November, 1915, and he was delighted to find his books and many of his papers still in his cabin.

The Navy had been waiting over twelve months for this chance. It had been a long and tedious period, broken only by occasional long-range firing, for the rôle of the Tigris fleet had become that of a heavy battery in trench warfare. In this last phase they became cavalry and horse artillery combined.

On March 7 the flotilla arrived at the famous Ctesiphon position, and found it deserted. It had been entrenched, and there was ample evidence that the Turks had fully intended to make a big effort there; but apparently it had been found impossible to rally them.

The final stand in front of Bagdad was made by the Turks on the banks of the Dialah river, which joins the Tigris about 8 miles below the city. Though the enemy's forces were so much depleted that the line was not held in very great strength, they managed to offer serious resistance; so much so that a detachment was sent to deal with them to the south and south-west of Bagdad. This detachment gradually made

its way up the right bank of the river, and, on March 10, put the enemy's rearguard to flight.

In the afternoon of March 11, 1917, the gunboat flotilla arrived at the Citadel. For the first time in history the Union Jack was hoisted by General Maude over this city of the Caliphs.

The Admiralty's letter of April 28, 1917, was greatly appreciated by the Yarrow firm.

“ ADMIRALTY,
“ LONDON.

“GENTLEMEN,—My Lords Commissioners of the Admiralty have been informed of the satisfactory completion at Abadan of the last of the gunboats constructed by your firm in this country.

These vessels are carrying out excellent work in H.M. Naval Service, and My Lords desire that you will express to Sir Alfred Yarrow personally and to the whole of your Staff who were concerned in the design and construction of the vessels their high appreciation of the successful results attained, which have been demonstrated under the severe test of active service in time of war.

“ I am,

“ Gentlemen,

“ Your obedient Servant,

“ (Signed) W. GRAHAM GREENE.

“ To Messrs. Yarrow & Co.”

CHAPTER XXIX

MISCELLANEOUS WAR WORK

Apart from building destroyers and gunboats in his shipyard, Yarrow occupied a large portion of his time during the War in devising numerous helpful schemes. The writer, having lived in the midst of the planning of these activities, is able to give many reliable particulars concerning them which, it is hoped, will be of interest to the reader.

EXPERIMENTS TO TEST THE EFFECT OF RUBBING THE LEGS AND FEET WITH OIL, IN ORDER TO AVOID FROST-BITE

On the Declaration of War it was realized that the Convalescent Home for Children at Broadstairs might be liable to attack from the enemy's ships. The Home was therefore closed. Situated within reach of Dover, it was decided to use it for wounded soldiers who came from the seat of war, and it was converted into a well-equipped Military Hospital.

During the winter soldiers arrived from the trenches with frozen feet, and in many such cases amputation of the feet, and even the legs, became necessary.

When Yarrow discussed this matter with his Staff, it was pointed out to him by Mr. Marriner that the heat of the body, or any part of it, might be retained by being rubbed with oil, owing to its non-conductivity. Yarrow determined to investigate this, and selected

four able-bodied men in robust health for the purpose. He filled the bath in his private house with water, which was maintained at a temperature of 50° F., and the four men to be experimented on sat on the edge of the bath with their legs in the water. Each man's temperature was taken at the start (in the mouth by two clinical thermometers), also at the end of an hour, and in each case it fell from 98.4° to 97° .

A similar experiment was made the following morning, the same period having elapsed after breakfast. On this occasion the legs and feet of the men were well rubbed with whale oil. The temperature at the start was 98.4° , as before, and at the end of an hour it was found to be 98.2° . That is to say, the fall of temperature at the end of the first experiment was $1\frac{4}{10}$ th degrees, and in the second experiment, with the legs oiled, the drop was only $\frac{2}{10}$ ths of a degree. At the termination of the first experiment the men felt cold and miserable ; but throughout the second experiment they remained warm and comfortable.

These tests pointed to the probability that if the troops rubbed their legs with oil before going into the trenches, they would be better able to resist the effects of cold during the winter.

Yarrow thought the matter of so much importance that he communicated the results to Lord Kitchener, and suggested that oil be sent out to France, to test the effect of rubbing the legs of the men with it under actual conditions of trench warfare. So prompt was Lord Kitchener's action that he wrote within two days, saying that as suggested, some barrels of whale oil were being sent to the Front. The result, as is generally known, was conclusive, and it became a War

Office Order that during the winter all soldiers in the trenches should rub their legs with oil or grease, and finally it was treated as an offence against discipline if any men were found suffering from frost-bitten feet.

Lord Dawson, who took an active part in the medical arrangements in France, mentioned the case of a man who had one leg amputated while the other was sound. On being asked how this came about, the man explained that he only had time to rub one leg with oil, which leg was the one saved.

THE MILITARY VEIL

Early in the War Eric Yarrow frequently wrote to his father concerning the loss of our men through German snipers, and pointed out that the white faces formed good targets. He suggested that if the face were suitably covered it would form a great protection. Following his son's idea, Yarrow had a number of veils made of a thin material, the colour of which was determined so as to correspond with the surroundings at the Front. Curtain rings were fitted in them to serve as eyepieces.

Owing to the success of these veils, Yarrow offered Lord Kitchener to send out 1,000 to the troops, if the War Office would accept them and report on their usefulness. The offer was accepted, the veils were sent, and the following letter was received from the Director of Equipment:—

“WAR OFFICE,

“LONDON.

“16th August, 1915.

“With reference to your letter, dated 30th ultimo, to the Chief Ordnance Officer, the 1,000 veils kindly presented by

you and sent overseas for trial have been found to be very useful for snipers, scouts and observers."

As a result these veils were ordered by the Government in large numbers.

THE "MIRANDA" WAISTCOAT

It will be remembered that early in the War the three cruisers *Cressy*, *Hogue* and *Aboukir* were sunk by submarines which were lying in wait for them, the Germans having been informed by their spies that these cruisers were about to pass along the Dutch coast. A large number of British sailors were drowned, because, although the sea was calm, they were unable to keep afloat long enough to be saved by the small boats available.

On noting this, Yarrow turned his attention to designing a form of waistcoat which might always be worn, "Because," he said, "the blowing up of a vessel is so sudden that there is not often sufficient time to put on any safety appliance."

The principal conditions, in his opinion, to be complied with were :—

(1) That the waistcoat should have buoyancy enough to keep a man well out of the water.

(2) That it should not when worn have the look of a life-saving device, or sailors would refuse to wear it continuously.

(3) That it should not in the least impair the movements of the arms and legs.

(4) That there should be no fear of its shifting its position if its wearer were suddenly thrown into the water.

After testing various buoyant materials, such as powdered cork, Yarrow determined upon using kapok,



WITH THE VEIL



WITHOUT THE VEIL



MIRANDA WAISTCOAT

which, although in appearance like cotton-wool, differs from it in possessing remarkable buoyancy. Kapok is found in the pod of a tree grown in the East, the best being obtained from Java. Its buoyancy is due to the fineness of its fibres and to its greasy nature, which resists the absorption of water.

After many experiments it was determined that the buoyancy of the waistcoat, after being in the water for an hour, should be sufficient to keep afloat a bar of iron weighing 14 lb.

These waistcoats, known as "Miranda" waistcoats, were distributed very widely. Eighty were given to each destroyer built at Scotstoun, and they were so successful that the Admiralty ordered them in very large quantities.

The following extract is taken from a report by some one who was on board the *Sussex* when she was torpedoed :—

"My attention was drawn to three people who were thrown into the water :

"(1) A lady, who wore some buoyant device which, unfortunately, slipped towards her feet causing her head to sink under water ;

"(2) A passenger, wearing an inflated waistcoat, who remained afloat until it became pierced by a piece of wreckage. Its buoyancy was then destroyed, and he sank ;

"(3) A third, who had on a 'Miranda' and was saved. Although unconscious when rescued this man's head was well above water, and he soon recovered."

Numerous instances occurred during the War where men were saved through these waistcoats. One man was actually thrown into the sea on three occasions, and each time this device kept him afloat.

The following extracts from letters received are

further testimony to the usefulness of these waist-coats:—

From Engineer-Commander E. K. Boddam Whetham, of the destroyer *Ulleswater*, which was sunk during the War:—

“The majority of the men were wearing ‘Miranda’ waist-coats, and they were of the greatest value in saving life. Only five men were killed or drowned.”

From Arnold Clarke:—

“We were patrolling off the Norwegian coast in August, 1915, when we were torpedoed. I just had time to put on your ‘Miranda’ waistcoat when the ship sank. It was only this that brought me to the surface and kept me up until I reached a broken raft, from which we were picked up two hours later.”

From the photograph it will be seen that the waist-coat was in appearance an ordinary garment, and there was nothing to show that it was a life-saving device.

PROPAGANDA IN THE NEUTRAL PRESS

At the onset of war Yarrow realized the urgent necessity for informing the public in neutral countries through their Press of the actual events as they occurred, and of the facts which led up to the War; otherwise, he contended, the lies disseminated broadcast by the Germans would penetrate throughout the world and influence public opinion adversely to this country.

Under the heading, “News in Neutral Countries,” a powerful leader in *The Times* of May 29, 1915, stated:—

“One important subject which lies before the new Government, and which requires prompt attention, is the dissemination

of authentic news in neutral countries. No one wants the British Government to stoop to the level of the German Press. On the other hand, what the neutral nations want is authentic news which should be handled on the spot by competent people of special experience. We should not be too proud to counter-act German lies and to let the neutral countries know the truth."

Two days later the following letter from Yarrow appeared in *The Times* of May 31, 1915 :—

NEWS FOR NEUTRALS

To the Editor of THE TIMES.

SIR,—I have read with great interest your article in *The Times* of to-day headed "News in Neutral Countries." You are doing an incalculable service to the country in drawing attention to the desirability of taking steps to ensure the dissemination of authentic news about the War in the foreign Press. I annex a copy of a letter received from a firm of Press experts of the first standing in London, which speaks for itself. As public opinion in foreign countries is largely determined by the Press in those countries, it is essential that they be fully informed of the truth concerning the War, which at present they are not. The interests of Great Britain demand that the facts which led up to the War and the methods adopted by our enemies during the War be made known throughout the world, and to this end, whatever is honourable and proper should be done, and that promptly. We must not forget that "THE PEN IS MIGHTIER THAN THE SWORD."

Yours truly,

GLASGOW, *May 29th.*

A. F. YARROW.

Enclosure to above.

"*April 25, 1915.*

"In accordance with your instructions we have made a thorough search through the foreign Press published during the last two months, and can find no evidence of foreign countries being supplied with authentic information concerning the War from the British standpoint ; but, on the other hand, we find a continuous supply of evidently inspired articles giving the German inaccurate statements."

Yarrow had received numerous letters from abroad, stating that the general impression prevailed that the War had been brought about by the Allies, that the Germans, upon whom it had been forced, were fighting for their existence, and that in consequence a feeling favourable to our enemies was growing up. He paid several visits to the Foreign Office in order to urge that energetic steps should be taken to counteract this menace, contending that to make known the facts in countries hitherto misinformed could not be considered below the dignity of the British Empire, but was actually a duty we owed to the world. One of the people he interviewed on the subject was Sir Arthur Nicholson, Permanent Under-Secretary for Foreign Affairs.

Nothing worth mentioning was done, and Yarrow started on propaganda at his own expense, sending extracts from the British Press each week to 1,400 newspapers in different parts of the world, having them translated into such languages as was possible, and, where this was not practicable, offering to pay the expense of having translations made in each country to which the article was sent.

A few examples are given :—

1,400 copies of the following were posted to the Foreign Press, May 26, 1915 :—

ASPHYXIATING GASES

HAGUE CONVENTION VIOLATED

BY

THE GERMANS

The use by the GERMANS of poisonous gases as a means of warfare was recently referred to by Lord Kitchener, as being

contrary to the solemn pledge signed by the German representatives at The Hague Convention.

Speaking in the House of Lords on April 28, Lord Kitchener said :—

“The GERMANS have introduced a method of placing their opponents *hors de combat* by the use of asphyxiating and deleterious gases, and they employ these poisonous methods to prevail when their attack, according to the rules of war, might have otherwise failed. On this subject I would remind Your Lordships that GERMANY was a signatory to the following article in The Hague Convention :—

“ ‘The Contracting Powers agree to abstain from the use of projectiles, the object of which is the diffusion of asphyxiating or deleterious gases ! ’ ”

The above was signed by the representatives of :—

GREAT BRITAIN	July 29, 1899
Belgium	” ”
Denmark	” ”
Spain	” ”
United States of Mexico	” ”
France	” ”
Greece	” ”
Montenegro	” ”
Netherlands	” ”
Persia	” ”
Portugal	” ”
Rumania	” ”
Russia	” ”
Sweden and Norway	” ”
Turkey	” ”
Bulgaria	” ”
GERMANY	September 4, 1900
Austria-Hungary	” ” ”
Italy	” ” ”
Japan	October 6, 1900
Switzerland	December 29, 1900
Servia	May 11, 1901
Luxemburg	July 12, 1901
China	November 21, 1904

1,400 copies of this letter, which first appeared in the *Daily Graphic*, were posted to the Foreign Press, June 9, 1915:—

SWEDEN AND GERMAN BARBARITY

LETTER OF PROTEST AGAINST ENEMY'S METHODS OF WARFARE

To the Editor of the DAILY GRAPHIC.

SIR,—English people know that the Swedish nation is practically unanimous in supporting the Government in its policy of strict neutrality. Yet a large section of the people, whether the majority or not we cannot say, is anything but neutral in their feelings at the methods of warfare which have been adopted in this terrible war, and have culminated in the sinking of the *Lusitania*.

The misconception that war suspends all laws of humanity must prove fatal to the future of civilization and disastrous for that human solidarity that is of such vital interest to the smaller nations especially.—Yours faithfully,

SVANTE ARRHENIUS, Professor.

BARON ADELSWARD.

VICTOR ALMQUIST, Chief

Director for State Prisons.

W. LECS, Professor.

KNUT KJELLBERG, Professor.

JULES AKERMAN, Professor.

TORGNY LEGERSTEDT, Professor.

ISRAEL HOLMGREN, Professor.

G. KOB, Professor.

OTTO ROSENBERG, Professor.

GUNNAR ANDERSON, Professor.

GERHARD DE GEER, Professor.

OLOF KINBERG, M.D.

ALFRED PETREN, M.D.

JOHN TJERNELD, Barrister.

TOR HEDBERG, Author.

HJALMAR SODERBERG, Author

G. STJERNSTEDT, Barrister.

IVAN HEDQUIST, Actor at Royal Theatre.

IVAN BRATT, M.D.

T. FOGELQUIST, Rector.

Mrs. EMILIA BROOME.

Miss SIGNE HEBBA.

CHRISTIAN ERIKSEN, Sculptor

LUDVIG MOBERG, M.D.

KARL NORDSTROM, Artist.

NILS KREUGER, Artist.

ARNOLD JOSEFSON, M.S.

CARL ELDH, Sculptor.

Miss ALMA SUNDQUIST, M.D.

STOCKHOLM, May 10, 1915.

1,400 copies of this extract from *The Times* of May 20, 1915, were posted to the Foreign Press, June 23, 1915 :—

SAVING GERMAN CREWS

A COMPARISON IN NAVAL WARFARE

A return showing the "number of rescues that have been effected from German warships by His Majesty's vessels and from His Majesty's vessels by German warships respectively" was issued yesterday by the Admiralty. It affords a striking illustration of the different methods adopted by Great Britain and Germany in waging warfare at sea.

From the return, which is given below, it will be seen that 1,272 members of the crews of German warships lost have been rescued by the British warships engaged, while German warships have not rescued a single man belonging to British warships in similar circumstances.

GERMAN WARSHIPS LOST (INCLUDING SUBMARINES), PART OF WHOSE CREWS HAVE BEEN SAVED

Name and Date.	No. of Men saved.	Names of H.M.'s Ships that rescued them.	Remarks.
Königin Louise (mine layer), August 15	57	Lance and others	Sunk in North Sea.
V 187 (destroyer), August 28	31	Goshawk, Lizard, Lapwing, Phoenix and Submarine E 4	Sunk in North Sea. (In addition to these, 30 or 40 were picked up in Defender's boats, supplied with provisions and a compass and directed to Heligoland, as they could not be taken on board Submarine E 4, the only British vessel then present.)
Mainz (light cruiser), August 28	353	Liverpool, Lurcher and Firedrake	Sunk in North Sea. (A number of these subsequently died.)
S 115 } (destroyers) {	5	Lance	Sunk in North Sea.
S 117 }	3	Loyal	
S 119 }	27	Lennox, Legion	
October 17			
Emden (light cruiser), November 9	190	Sydney	Destroyed at Cocos Island.
U 18 (submarine)	26	Garry	Sunk near Pentland Skerries.
Gneisenau (armoured cruiser)	190	Invincible, Inflexible, Carnarvon, Glasgow, Cornwall, Kent	Sunk near Falkland Islands.
Leipzig (armoured cruiser)	20		(Several died subsequently.)
Nurnberg (light cruiser), December 8	12		
Blücher (armoured cruiser), January 24	283	Arethusa; Undaunted, and others	Sunk in North Sea.
U 8 (submarine), March 4	29	Boats from Nubian and Maori	Sunk off Dover. The whole crew rescued.
A 2, A 6 (torpedo-boats)	46	Lark, Lawford, Laforey, Leonidas	Sunk in North Sea. (Including one dead when picked up.)

British Sailors saved by Germans :—NONE.

1,400 Copies of this were Posted to
the Foreign press in all parts of the
world, Wednesday, June 30, 1915.

THE TRUTH OUT.

WAR WAS DECLARED ON AUGUST 4th.

By FREDERIC WILLIAM WILE,
Late Berlin Correspondent of "The Daily
Mail."

Truth will out. The *Hamburger Fremdenblatt* has just disclosed a bit which I reproduce for the benefit of future historians. It will be recalled that Germany's plea of self-justification for the War insists that the peace-loving Kaiser only drew the sword "forced" into his hand by the bellicose Czar—in other words, that Germany was goaded into war by the "menacing mobilization" of the Russian Army on her frontiers during the last two or three days of July. Up to that hour—according to German protestations—the Fatherland had made no military move of any kind. The *Hamburger Fremdenblatt* of May 18, in the course of a flamboyant panegyric on the achievements of the German State railways in connection with mobilization, obligingly states :

The German railway system proved that it was at the zenith of capacity when, on nine different lines, 384,000 troops with their full equipment were transported to the frontier during the ten days between July 24 and August 4. The systematic employment of railways for the deploying of great armies therefore occurred for the first time in this war.

During the above period the German Government were pretending to desire peace, as proved by the official papers.

Perhaps the most forcible extract sent abroad by Yarrow was that taken from the spirited indictment (published in *The Times* of November 30, 1914) by

Professor Church, President of the Carnegie Institute, Pittsburg, as follows :—

We find ourselves shocked, ashamed, and outraged that a Christian nation should be guilty of this criminal war. There was no justification for it. Armed and defended as you were, the whole world could never have broken into your borders. And while German culture still has something to gain from her neighbours, yet the intellectual progress which Germany was making seemed to be lifting up her own people to better things for themselves and to an altruistic service to mankind. Your great nation floated its ships in every ocean, sold its wares in the uttermost parts of the earth, and enjoyed the good favour of humanity, because it was trusted as a humane State. But now all this achievement has vanished, all this good opinion has been destroyed. You cannot in half a century regain the spiritual and material benefits which you have lost. Oh, that we might have again a Germany that we could respect, a Germany of true peace, of true progress, of true culture, modest and not boastful, for ever rid of her war lords and her armed hosts, and turning once more to the uplifting influence of such leaders as Luther, Goethe, Beethoven, and Kant ! But Germany, whether you win or lose in this war, has fallen, and the once glorious nation must continue to pursue its course in darkness and murder until conscience at last bids it withdraw its armies back to its own boundaries, there to hope for the world's pardon upon this inexpiable damnation.

For some unknown reason the Foreign Office requested Yarrow to desist from sending extracts from the Press to foreign papers, and they even went the length of stopping such communications in the post. After this happened, editors of many foreign papers in search of the truth begged that they should be continued. This occurred particularly in Bulgaria, where there was a strong section of public opinion against the action of the King.

In consequence of letters received from Greece complaining that national feeling, although in favour of the British at the commencement of the War, was gradually changing, Yarrow made preliminary arrangements with the former *Times* correspondent at Athens, to proceed to Greece with a view to placing the truth before the Greek nation. Prior to so doing, Yarrow informed the Foreign Office of this project, and the following reply, dated June 7, 1915, was received *by return of post* from Sir Arthur Nicholson :—

“I have received your letter of the 7th instant, proposing that a gentleman known to you should proceed to Athens with a view to influencing the Greek Press, and while appreciating your interest in this question, I am of opinion that any such mission as you propose is not desirable, and might be harmful to the interests of the Allies.”

The action of the Foreign Office is a mystery, for it is inconceivable to imagine that they did not appreciate the importance of maintaining the favourable opinion of neutral countries, upon whom we were dependent for supplies, and who might possibly, if wrongly influenced (which actually occurred), join our enemies. One could understand that the Foreign Office might resent anyone outside the charmed circle of Government officials telling them what they should do, but to forbid a British subject from taking steps at his own expense to make known the truth in foreign parts in such a life-and-death struggle is beyond comprehension.

Yarrow, finding it hopeless to convince the authorities that a Press propaganda carried out on sound lines was of the first importance, laid his views

personally before His Majesty the King, who requested that they should be confirmed to him in writing.

It should be understood that the scheme was to inform neutral countries of indisputable facts, and in support of this contention he quoted a saying of Bismarck's: "The Press determined public opinion, and public opinion determined the acts of nations." He maintained that some one of almost ministerial rank should be appointed with a free hand and ample means to carry out this work, assisted by men having direct knowledge of the Press of the world; but all his efforts at the time were of no avail. Various committees were appointed which led some people to think that what was necessary was being done, and this closed the mouths of many who were persistent in their efforts to rouse the authorities to the importance of the matter.

Had a vigorous Press propaganda circulating the truth, and only the truth, been adopted at an early period of the War, there is little doubt that it would have had a very far-reaching effect; and the true reason for the refusal of the Foreign Office to carry out what every intelligent man must have recognized as being of primary importance in fighting such an enemy, must remain within the precincts of Downing Street.

That Yarrow was not alone in realizing the necessity for taking proper steps to inform the world of the facts was frequently illustrated by letters and articles in the daily papers, of which the following two examples are typical:—

Daily Record and Mail, October 8, 1915.

M. VENIZELOS'S TAUNT.

GREEK JOURNALISTS BRIBED WITH GERMAN GOLD.

PARIS, Thursday.

The *Matin's* correspondent at Athens sends the following message under Tuesday's date:—

A lively incident illustrating the real feelings of the Greek Parliament and people occurred during the sitting of the Chamber. M. Venizelos, after having repeated that the Cabinet intended to fulfil its obligations towards Serbia in case Bulgaria attacked that country, added, turning towards the Press gallery, "*only some journalists corrupted by foreign gold can dream of preventing Greece from pursuing the path of honour.*"

Some of the journalists rising in order to protest, the Premier called out in a loud voice, "Go. Your place is not here."

At these words the entire assembly burst into applause, and loudly cheered the Premier.—(Reuter.)

The Times, November 22, 1915.

PUBLIC OPINION IN HOLLAND.

To the Editor of THE TIMES

Sir,—I have read the article from "A Correspondent Lately in Holland" in *The Times* of to-day, and what he says is quite true. I have myself heard the report of which he speaks, that the entire British Armies to-day amount to not more than 600,000 men, and I have reason to know that the story is believed by persons in close relation to our Government. Nothing that Germany can say will make the people of Holland sympathize with Germany, but by continual repetition of stories like the above she may succeed in weakening our belief in the reality of England's military strength.

I confess that I myself until I came to England this time had no idea how great was the effort that Great Britain is making. I had not been here a day before I knew that the story was ridiculously false. But only a few people from Holland can come to England to see things for themselves. *It seems to me most unfortunate that the Germans should be allowed to carry on the active propaganda that they do in Holland with so little reply or contradiction from the side of the Allies.*

I am, Sir, yours,

LOUIS RAEMAEEKERS.

Savoy Hotel, Nov. 20.

Yarrow's efforts in this direction during the early part of the War were certainly not appreciated, but it is quite possible that not only did they assist in spreading the truth among neutral nations, but had the effect of opening the eyes of our own authorities to the importance of this work. That they were on the right lines is proved by the violent resentment expressed by the Germans at Lord Northcliffe's action in distributing leaflets among their troops, a piece of propaganda which the Germans themselves say hastened the termination of the War.

FLY AND MOSQUITO EQUIPMENT

Our troops in France and the East complained very bitterly of the misery they suffered from flies and mosquitoes. It was even said that they were a worse pest in hot weather than the shells of the Germans, making it impossible for the men to eat or sleep.

Using the recipe of Professor Lefroy, Yarrow sent to the troops a very large number of sprayers with a preparation suitable for meeting this trouble. It not only destroyed these creatures, but prevented their approach, and undoubtedly had a beneficent effect upon the health and comfort of our men. The officer in command of one British camp in Egypt wrote to Yarrow that, although typhoid fever raged in an adjoining camp of Turkish prisoners, where many deaths occurred, the British camp remained free from infection owing to the fly equipment, which prevented the mosquitoes and flies from entering the tents and contaminating the food.

The following is one of a vast number of similar letters received in praise of the anti-fly equipment :—

“FRANCE,

“SIR,—I have received three parcels from you up to date, containing fly-spray outfits, for which please accept my heart-felt gratitude. I have used them with splendid results. At last we have peace upon earth as far as vermin are concerned.

“Yours very truly,

“R. BOMFORD,

“Aus. E.M.M. and B. Co.”

ARTIFICIAL LIMBS

The War had not long commenced when it was realized that the necessary steps for providing artificial limbs promptly were not being taken, and that a man needing an artificial leg had frequently to wait for it many months.

This delay is undesirable for two reasons: for one thing, without his new leg, the man is unable to get employment, which is demoralizing to both body and mind; and, secondly, it is bad for the stump not to be brought into use as soon as it is ready to receive the limb.

Yarrow paid several visits to Chelsea Hospital, where such matters were controlled, and was told that ample provision was being made to supply limbs as soon as they were needed; but the facts did not bear out this statement. Limbs were being made at Roehampton, where some Americans had been engaged for the purpose, but the means of supply were below the requirements.

As the Japanese had specialized in the manufacture of artificial limbs, owing to the number of their own soldiers disabled in the war with Russia, Yarrow imported fifty sets of limbs of different designs from Tokio, so as to have the benefit of their experience.

Finding that the authorities failed to use the necessary energy in supplying the wounded men with arms and legs, Yarrow determined to start making them at his shipbuilding works at Scotstoun, and took, among other models, limbs that had been made during the last twenty-five years at Crewe by the L. & N.W. Railway Company. These appeared to combine the best features of every design, and ultimately the pattern shop at the works was one-third occupied with making arms and legs. His sole object in undertaking this work was to meet the demand, needless to add it was carried out at considerable expense.

Yarrow often assured patients that it should be some consolation to them to know that, if of a healthy constitution, it is quite possible that life may be prolonged by the loss of a limb, because the heart has in consequence less work to do, and will therefore last longer.

NOTE.—Yarrow's son Harold became convener of the committee for the supply of limbs to the Princess Louise Hospital at Erskine, near Glasgow.

£20 REWARD FOR SIGHTING SUBMARINES

Early in 1917 the greatest anxiety prevailed in consequence of the vigorous and inhuman attacks made on merchant ships by the German submarines, vessels being sunk with entire disregard for the safety of women and children, and contrary to the rules of International Law. Obviously it was of the utmost importance to discover at the earliest possible moment if a submarine were in the vicinity of a ship and the greater the number of people who were on the look

out, the greater the probability of the submarine being quickly sighted.

In order to stimulate all on board, Yarrow offered a prize of £20 to anyone on a British merchant ship who first discovered a submarine; and owing to the vigilance thus aroused, many submarines were sighted in time to give a vessel an opportunity to escape.

This offer appeared in *The Times* of March 1 and April 2, 1917, as follows:—

SIGHTING SUBMARINES

A REWARD

To the Editor of THE TIMES.

SIR,—It goes without saying that it is of the utmost importance to sight a submarine at the earliest possible moment. To encourage every one to keep a sharp look-out, I beg to offer a reward of £20 (up to a total expenditure of £10,000) to anyone on board a commercial vessel who first draws the captain's attention to an enemy submarine in the vicinity.

The reward will be paid on a certificate from the captain giving the name of the person who first draws his attention to an enemy submarine, and a statement signed by the captain saying that the submarine was actually sighted. The application should be forwarded through the owners to Sir Thomas L. Devitt, Bart., Chairman of Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C., who has kindly consented to make the awards.

I am, Sir, your obedient servant,
Hindhead. A. F. YARROW.

REWARD FOR SIGHTING SUBMARINES

We are requested by Sir Alfred Yarrow to state, in reply to inquiries received, that this offer of a reward for sighting

submarines, which appeared in our issue of March 1, is intended to apply to any person on board a merchant ship flying the British flag who first draws the attention of the captain to an enemy submarine.

It does not apply to trawlers, fishing vessels, or vessels under 300 gross tons.

There was in such a reward an element of sport which appealed to the British, and many sums of £20 were paid to cabin-boys and people of varying positions, whose duty did not include keeping a look-out. There were men placed in the crow's nest, at the bow, and elsewhere, as usual, in order to scan the horizon, but the vision becomes less acute after keeping a look-out under conditions of exposure for long periods. In many cases the gift of £20 was presented by the captain of the ship in the presence of the crew, or in the lad's home, and an interesting ceremony took place.

Letters were received from all the leading shipping companies, referring to the usefulness of the scheme, and the following testimonial came from the Admiralty:—

Copy.

THE ADMIRALTY,

S.W.1.

June 20, 1918.

SIR,—I am commanded by My Lords Commissioners of the Admiralty to convey to you their high appreciation of your generosity in offering during the past fifteen months a reward to the person on board a commercial vessel who first draws the captain's attention to an enemy submarine.

Their Lordships have studied with much interest the details of the applications received since March, 1917, and

feel that your public-spirited action must have had a most stimulating effect in promoting efficiency in the system of look-outs on board vessels of our Mercantile Marine.

I am, Sir,

Your obedient Servant,

(Signed) CHARLES WALKER.

SIR ALFRED YARROW.

After 500 rewards had been given, and the fund thereby exhausted, it was continued by the Chamber of Shipping of the United Kingdom, the Committee of Lloyds, and the Liverpool & London War Risks Association.

In referring to this scheme, Yarrow always said, if there was any credit in this idea it should be shared by Mr. Whiting, of the Admiralty, because it came about as the result of a conversation with him.

REWARDS FOR DESTROYING SUBMARINES

In addition to the Sighting Submarine Scheme, Yarrow placed a sum of £20,000 at the disposal of the Chairman of Lloyd's Register, to be used for premiums to captains, officers, and crews of those merchant ships which succeeded in sinking submarines.

Yarrow proposed this scheme to the Admiralty many weeks before it was carried out. Owing to the mysteries of International Law, it was considered illegal to offer any inducement to those on board a merchant ship to attack a submarine, unless the former had been first attacked.



ARTIFICIAL LIME-MAKING.



A CONTRAST BETWEEN A VESSEL WITH THE YARROW
ANTI-SUBMARINE SMOKE SYSTEM AND ONE WITHOUT

The following announcement on the subject appeared in *The Times* of July 7, 1917:—

REWARDS FOR DESTROYING SUBMARINES

A GIFT OF £20,000

To the Editor of THE TIMES.

SIR,—There is a widespread feeling that the bravery and patriotism of our merchant service is not sufficiently appreciated by the general public. The Admiralty have recently offered awards to British merchant ships for successful action in self-defence against enemy submarines and warships, providing for the payment of an amount not exceeding £1,000 for the capture or destruction of any enemy submarine or other ship of war. It may interest your readers to know that I have received the sum of £20,000, and have been asked by the donor to administer the same in gifts of £1,000, to be divided between the captain, officers, and crew of any merchant ship, flying the British flag, which after this date succeeds, in the opinion of the Admiralty, in capturing or destroying an enemy submarine. Applications for this reward should be made through the owners to the Chairman of Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C.3.

Yours obediently,

THOMAS L. DEVITT.

71, FENCHURCH STREET,

London, E.C.3.

July 6, 1917.

There were only four authentic cases of submarines being destroyed or captured by merchant ships, and therefore only £4,000 of the above fund was spent, the remaining £16,000 being devoted towards the Merchant Seamen's Orphanage at Bearwood.

The ships which earned the rewards were:—

S.S. *Olympic*

S.S. *British Transport*

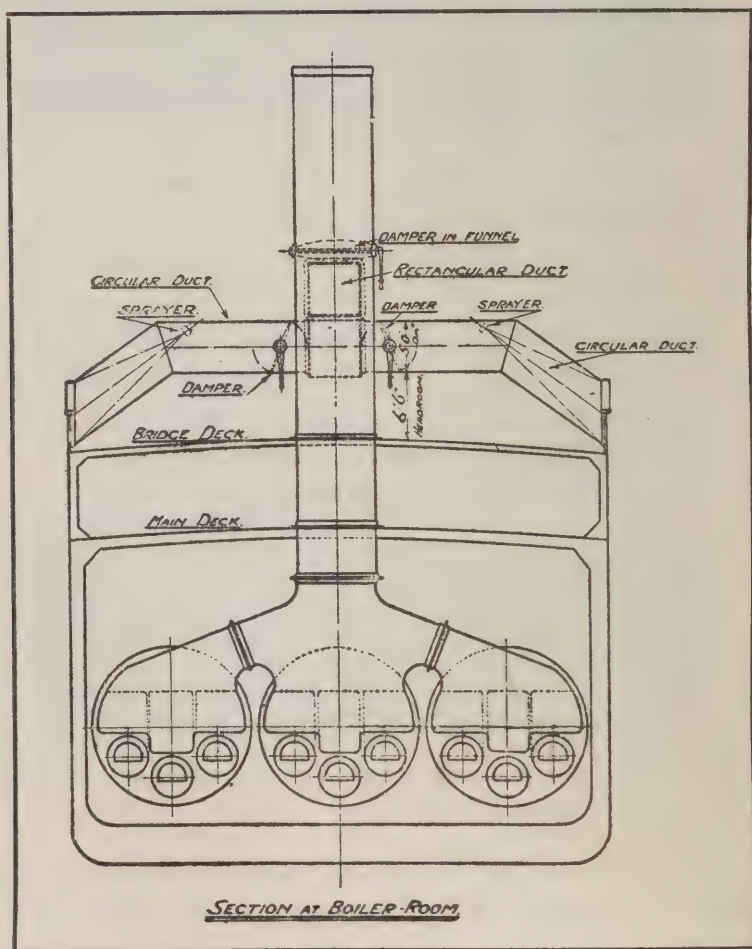
S.S. *Braeneil*

S.S. *Queen Alexandra*

Yarrow always said the thanks of the country were due to Sir Thomas Devitt and his staff for having investigated applications for rewards for sighting, and for destroying, submarines, as these investigations involved a colossal amount of work.

THE YARROW ANTI-SUBMARINE SMOKE SYSTEM

It is well known that the column of smoke is generally the first indication of the existence of a vessel



in the distance, and immediately the officer commanding a submarine, or raider, sees it, he starts off

to get into position to attack. If the smoke were not allowed to form a long trail in the sky, it is reasonable to assume that many vessels might pass unobserved.

With a view to reducing the loss of merchant shipping through submarine attack, Yarrow suggested to the Admiralty, in January, 1918, that the smoke from the funnels, instead of being allowed to pass up into the sky, should be conducted over the sides of the ships, and by means of a spray of water which would cool the products of combustion, caused to descend.

It may be mentioned that the spray of water had the effect of increasing the draught beyond what would be due to the vertical funnel, and thus a slightly increased speed was secured. This is referred to because it was thought by some that the scheme proposed would reduce the draught, and diminish the speed, while in actual fact the contrary effect was produced. It is well described in the following extract from *The Times* of August 31, 1918:—

BAFFLING THE U-BOATS

THE YARROW SMOKE SYSTEM

(*From Our Naval Correspondent.*)

“ Every seafarer will be aware of the way in which a steamer makes its presence known, by the long trail of smoke on the horizon before the ship herself is seen. This manifest sign of the whereabouts of a merchant steamer has been made use of by the German raiders and submarines to a very large extent, as the published accounts and journals of their achievements reveal. An example is furnished by Lieutenant Aust, of the *Karlsruhe*, who in his ‘Journal’ says, on one occasion: ‘We were all at high tension, wondering in what direction the first smoke cloud would appear’; and on another: ‘We were downcast over our bad luck in having to leave the main

commerce-lane when our look-out reported, "Smoke four points on the port bow," and our ship immediately livened up.'

"By the use of this device, the smoke is emitted over the sides of the ship, and thus, by the elimination of the tell-tale black column, the range of visibility to the enemy is reduced. On a clear day, the smoke from a steam-ship can be seen at a distance of over 17 miles. Assuming, however, that, as is the case with this system, the smoke rose no higher than the bridge, the distance at which the ship could be seen on a clear day would be a little over 10 miles."

Several ships were fitted with this device, but the termination of the War put an end to its further introduction. In its development, Yarrow was associated with Mr. Summers Hunter, of Newcastle-on-Tyne.

It should in justice be stated that none of the schemes described in this chapter were of any pecuniary benefit to Yarrow; in fact, in carrying them out, many thousands of pounds were spent.

CHAPTER XXX

ECONOMICS AND COMMON SENSE

Yarrow's view on the industrial situation after the War is perhaps best described in the article he wrote to *The Times* on September 9, 1921, a copy of which the author thinks of sufficient interest to quote in full:—

THE INDUSTRIAL SITUATION

ECONOMICS AND COMMON SENSE

In order to be fully informed regarding the conditions prevailing in those countries with which we have to compete, one of our directors recently paid a visit to China and Japan, I have lately returned from the United States, and we have commissioned an engineer, who has business relations both with this country and Germany, to visit Germany, Holland, and Belgium, to study conditions on the Continent. Consequently, in coming to conclusions, we have not been working in the dark, but have had first-hand modern information to guide us. I propose to deal with some of the first principles which govern good wages, continuous employment, and the prosperity of an industrial community.

This country is placed more unfavourably than any other for obtaining food for its people. We only grow enough to feed us for two days in the week; for the remaining five days we are dependent upon supplies from abroad. The United States, France, Italy and Germany are in a better position, because they grow within their own borders a large proportion of the food they need. The principal means we have of paying for what we import is by giving manufactured goods in

exchange, and if we fail to supply foreign countries with such goods, they will not send us what we want, scarcity will result, and prices will inevitably rise. If foreign countries give us credit, as they are doing, they will demand high prices to cover the risk they consider they run, which risk is shown by the depreciation of our paper currency. Thus, if we would have sufficient food, we must give the foreigner an equivalent in manufactured goods, or pay excessive prices if we need credit.

In order to induce foreigners to purchase those articles which we manufacture, not only must our factories be kept going, but we must be able to supply our goods at prices that will compare favourably with similar goods obtained elsewhere. If we cannot do this, then we lose our foreign customers, and are unable to pay them for the necessities of life. The question then arises: How are we to conduct our business so that our manufactures will compete successfully in the markets of the world? Argentina, for example, will prefer to send her meat and grain to a country from which she can get, in exchange, the goods she requires at lower prices than they can be supplied by us. The point is: Why are we outbid by other countries in low cost of production? The result of our investigations proves that if the prevailing conditions of doing work here continue, resulting in high cost of production, we shall no longer take a lead as a manufacturing nation, and it behoves us to change our ways, or engineering and ship-building will pass from this country into other hands.

DEMARCATIION

For example, take "demarcation," as it is called, between different trades. A man in one trade, who is also capable of fulfilling the conditions of another, by trade union rules is not allowed to do so. Suppose a joiner puts up a piece of woodwork that requires painting: although he is on the spot and quite capable of doing the painting himself, he must send for a painter. If an engineer has to erect some machinery which requires wood packing, he is not allowed to pick up the nearest handy piece of wood and fit it in place himself; he must send for a joiner. With perfect flexibility as regards demarcation, men would have more continuous employment,

and the costs would be reduced. Such restrictions are not found in Germany. Anyone there can do whatever is most convenient for his work, irrespective of the special trade to which he has been brought up. At the present time it is common knowledge there is an exceptional demand for small houses. We also know that a large number of engineers are seeking employment. Surely an engineer who deserves the name would be capable of giving a hand in house-building, but, by trade union rules, he is doomed to enforced idleness. Surely it is absurd to force a man to remain idle when there is work waiting for him to do? In order to execute work in the cheapest manner, every one should be perfectly free to take part in any employment, irrespective of trade distinctions. Unless such restrictions as I have mentioned are removed, it is useless for us to attempt to compete with other nations not hampered in these ways.

REDUCTION OF OUTPUT

With regard to the relative wages paid in different countries these are generally quoted "per hour," but the real value of a man's services does not depend upon the time he is in the workshop, but upon the amount of work he does when there. Consequently, to compare wages irrespective of efficiency is misleading. Those who have visited American, German and Dutch factories of late are convinced that we do not work up to the standard of efficiency now common in those countries, nor common in former days in this country. The practice of spinning out work so as to give longer employment has no doubt been instituted by trade unions with the best motives, but, unfortunately, the result of such practice is to secure temporary gain at the sacrifice of future permanent employment. Sometimes it is thought that this "ca' canny" system is due to the War, but such is not the case. Referring to the printed rules of the Amalgamated Society of Carpenters and Joiners, dated 1911, on page 115 it states:—

"No member shall provide a bicycle of any sort for the purpose of locomotion to and from any of his employer's jobs or works during working hours."

From this it would appear that it was a deliberate policy to delay completion of work so as to give employment for as long as possible, thus increasing the cost.

Solomon, who, I believe, was considered a wise man, said:—

“He becometh poor that dealeth with a slack hand, but the hand of the diligent maketh rich.”

What held good in Solomon's time does the same now.

STRIKES

Great Britain has become notorious throughout the world for continual strikes, and our good name as a manufacturing nation has greatly suffered in consequence. For example, a Minister of Marine would now be most reluctant to give an order to a British firm for destroyers because he would be aware there was no security as to when they would be delivered. He would naturally place the contract where there are firms prepared to guarantee dates of completion, knowing they can rely upon their men for steady, continuous work. If these dislocations of trade continue we shall certainly lose our industrial supremacy.

TRADE RESTRICTIONS

I have now shown you why we cannot compete with foreign firms, and I will proceed to illustrate the actual result of these various regulations. In constructional work recently an order for no less than 150 railway bridges for foreign railways has been placed with two Dutch firms. Formerly this country was celebrated for that class of work. Locomotive factories in Germany are very busy, and the directors of a British railway company in South America recently placed a large order in Germany for locomotives, although they would gladly have given the preference to a British firm. A friend of mine recently visited a large engineering establishment on the Continent, and as he was entering the principal's office three Englishmen came out. The chief told my friend he had just signed a contract with these three Englishmen to be executed at his factory for one million sterling for work which, he said,

before the War would have been carried out in Great Britain.

It is only human nature to buy in the cheapest market ; so equally it is natural that the capitalist will seek to use his money where he can secure the greatest return. Few people at the present time will entertain the investment of capital in industrial undertakings in this country ; and what will inevitably happen is that Germany will make renewed and greater efforts than ever to take her place in the industries of the world, and, having all its establishments intact and uninjured by the War, capital will gradually find its way into German hands.

TRADE UNIONS.

My belief is that unions may be productive of much good if they are wisely guided ; but, on the other hand, if they are influenced by false doctrines, although with the best intentions, they will continue, as they have done, to injure those they wish to benefit. This is no time for defying economic laws, nor using trade unions for political ends.

Provided wages are strictly in proportion to the work done, and not in proportion to the time spent in the workshops, high wages are often accompanied by low cost of production. For example, if Jones can do a piece of work in half the time that Smith can, Jones ought to be paid at least twice as much as Smith. I will even go a step farther, and say that it would be advantageous to the employer that Jones be paid a little more than twice what Smith gets. To explain my point : Let us assume a factory with 100 lathes and 100 men working them up to the maximum output. Now assume another factory with 200 lathes and employing 200 men, but each man only turning out half the maximum output. Suppose they get paid according to what they do. Both works will turn out the same amount and the men be paid the same total wages, but each man working up to the maximum will obtain double as much as the slower man will get.

Now, from an employer's point of view, the factory in the case of the men who work up to full capacity would be half the size, have half the number of tools, require half the capital outlay, and cost half for light and heat ; that is to say, although both factories turn out the same amount, the one where the

men work to their full capacity would cost considerably less for establishment charges, and, therefore, it would be reasonable for those men to have more than double the wages of those who work at only half their capacity; even then the total cost of production would be reduced. I think I have shown the reason why high wages are often accompanied by low cost.

UNEMPLOYMENT

If the foregoing restrictions to trade were abandoned, costs would be reduced, firms would be enabled to secure contracts, which now they are unable to do, and unemployment would be permanently and legitimately diminished.

It is often argued by the working community that as the prices of the necessities of life rose during the War and were followed by rises in wages, the same order of procedure should apply now, and that before wages fall there should be a drop in the price of commodities. This conclusion is incorrect. During the War the advance in prices was due to shortage, as a large number of our workers were withdrawn from industries. Also, there was great difficulty in obtaining supplies from foreign parts. Prices then advanced owing to insufficient supplies. At the present time the high price of commodities is not due to shortage, but to high wages. It is, therefore, out of the question for the price of commodities to be reduced unless they can be produced more cheaply; and as the cost of production is mainly dependent upon wages, until wages drop prices will not fall.

It should be borne in mind that it is erroneous to assume that low wages are necessarily accompanied by inferior conditions of living, which conditions are equally dependent upon the cost of commodities. In 1896, when the cost of living was at its lowest in modern times, and when wages were much lower than they are now, the artisan was actually better off than at any time since, because the purchasing power of money was far greater than in recent years.

SYMPATHY

I consider employers are often to blame for not exercising more sympathy than they do towards those in their employ.

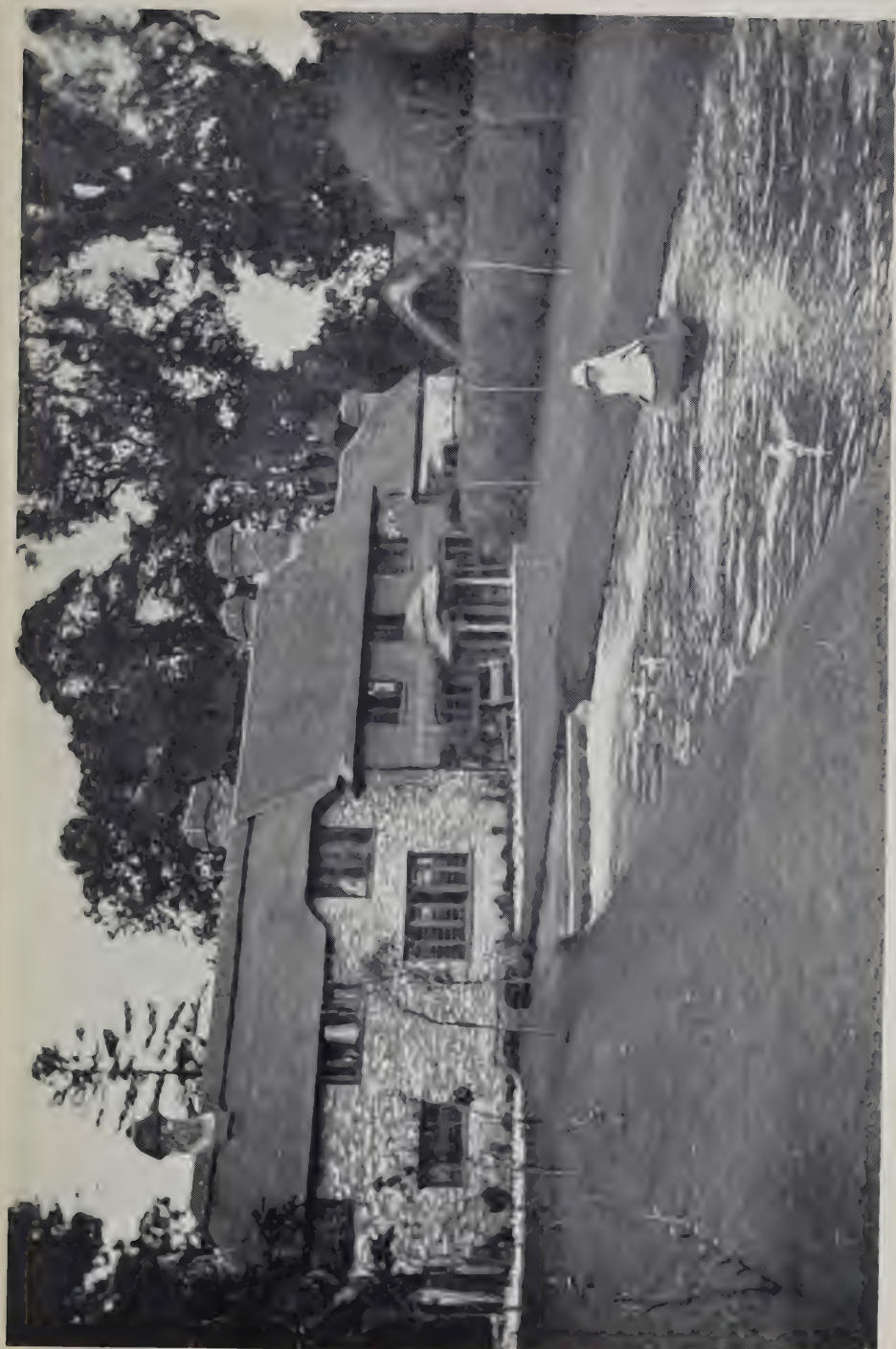
In order to secure this it is necessary for employers and employés to come into more intimate contact, and unless this is cultivated the gap will grow wider as factories grow larger. In Germany the employers do a great deal to secure comforts for their workpeople. They take much interest in the education of the workmen's sons, for which in many cases special excursions are provided of an educational and practical character. In Holland the great contentment among the workers is due to the personal intercourse existing between the principals and their men. At one of the largest factories, employing many thousands of men, the chief made a practice of remaining in his office after the bell for lunch had sounded, when anybody, from a labourer upwards, in the works could come and freely consult him upon any topic, whether private or business. This quarter of an hour, he said, did much towards creating a right spirit in the works.

Those who are willing to work and unable to obtain it should certainly be assisted by those who have the means to help ; but it is of the first importance that a premium on idleness by extensive doles, which is being done, should be avoided.

Although it has been wrongly said by those in authority that better conditions of life were to be expected after the War than before—which conditions we all naturally wish for—this contention is unreasonable, because every member of the community should be willing to bear a share of the universal burden. The price of deliverance was paid in its supremest form by those who gave their lives, but there is a part of the sacrifice to be made by those who remained in safety at home.

Perhaps a word in conclusion as to the part which our Government takes in connection with industries. During the War, when artificial conditions existed, special interference was admissible. It does not follow that when the War ceased such interference should be continued. I venture to think it would be wise for the authorities to allow industry to naturally adjust itself. It has been well said : " It would be far better if we had more business in Government and less Government in business."

In February, 1922, Sir Alfred was selected by the Council of the Royal Society for election as Fellow, and in May was formally admitted, an honour which Yarrow greatly appreciated.



GREEN MEADOWS

SIR ALFRED AND LADY YARROW'S HAMPSHIRE HOME

AUTHOR'S NOTE

A short chapter in the original book describing the intimate characteristics of Alfred Yarrow has been, through his inexorable decision, omitted, but the author claims the right, in this note, to mention one or two well-known and easily recognizable traits in the character of the subject of this memoir.

When it was mentioned to several friends, and particularly to some professional men, that this biography was to be written, it was remarkable that in each case the immediate response expressed the same thought: "Can you show how kind he is? Is it possible to paint half his kindness?"

With such a man as Yarrow, from whom, throughout life, kindness and encouragement have radiated unconsciously day by day, who has come into touch with thousands of people needing and asking his advice and help, who combines the gift of influence with the will to use it for good, it would be strange if any record of his life could be accepted as adequate.

How is it possible truly to describe the character of the man? It is impossible to satisfy the mind's eye, so critical, of the friend (and it is only for his friends that such description should be written), who knows and loves every tone and gesture, every phase of the varied personality. How can words bring to mind the warmth shown in a single greet-

ing, the sound advice given during some crisis in life, the comfort of a chat over some trial, the genial comradeship, the pleasant walk or dinner arranged to discuss some plan, the hand suddenly laid on the young man's shoulder, and, above all, the sympathy of an emotional nature for the wounded spirit or the suffering body ?

This book will naturally be read by people who have met, known, and loved the one about whom it is written. But no words, however eloquent, could bring adequately before them the man who to many must ever stand out in memory as their best friend in difficulty and trouble ; whose talent has ever been united to the power of showing sympathy in the most understanding manner, and who has left some trace of kindness wherever he has dwelt.

FACSIMILE OF A LETTER FROM ADMIRAL LORD FISHER TO
SIR ALFRED YARROW.

Sep. 24. 2 Beloved Yarrow

I enclose you a very inadequate
account of what you wished for
as the winter so afraid that
he won't allow me to mention
his name! It's very curious
this terrorism of silence!
We are the most despised
nation in the world though
our leaders be "imbeciles".
You (ages ago) I remember
condemned to read it and

Sent masses of publicity
at your own expense to all
quarters!

The German Submarine

Menace Still Lags!

And our building programme
remains far below the
destroyed programme!

Let the public & the press
as parliament remain
informed by the tenille
correspondence that

Must Come!

The Sea is Commanded
by the Land!

The Shortest route to Berlin
is still by the Sea -

It's the only route to the
End of the War!

Prodded if we had a Superior
Engine where we could "rope"
in Belgium & the Turks
let we have imbeciles!
we are still 100 miles from
Aleppo and 100 miles

from Sofia a incredible
loss of forts & borders
~~between us & the Rhine~~
as we are now now there
we were on March 21st last
when we lost 100 000 British
soldiers taken prisoners &
we lost also incredible numbers
of stores & munitions and
this dispatch never published
why it was !!!
Give Peace in our time: O Lord!
Yours Truly 24-9-61

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